

## **TERMS OF REFERENCE (TOR)**

### **PROCUREMENT OF A CONTINUOUS LOW-TO-MEDIUM-COST, NON-REFERENCE AIR QUALITY MONITORING SENSORS FOR QUEZON CITY**

#### **I. RATIONALE AND BRIEF BACKGROUND**

Section 36 of Republic Act No. 8749 also known as the Philippine Clean Air Act of 1999 states that: *"Local Government Units (LGUs) shall share the responsibility in the management and maintenance of air quality within their territorial jurisdiction."* With this, air quality management has been integrated in the City's development plans. Objective 4 of the City's Comprehensive Development Plan 2021-2025 aims to promote sustainable urban development without compromising the future environmental condition and Strategy 2 under this objective intends to enhance the quality of the City's air to the levels meeting the standards of the Department of Environment and Natural Resources – Environment Management Bureau (DENR-EMB).

Aside from meeting the goals set out in the said plan, the City Government also made several commitments internationally with the signing of the C40 Clean Air Cities Declaration and the BreatheLife Campaign of the World Health Organization, the United Nations Environment Programme and the Climate and Clean Air Coalition.

Establishing a network of air quality monitoring equipment and sensors will enable the City to gather the necessary air quality data which can be used in developing effective interventions and formulating a comprehensive Air Quality Management Plan.

#### **II. PROJECT DESCRIPTION, OBJECTIVES AND AREA OF COVERAGE**

The Quezon City Local Government, through the Environmental Protection and Waste Management Department (EPWMD), intends to engage the services of a qualified Service Provider duly authorized and with the appropriate expertise, experience, and capacity to supply, deliver, calibrate and maintain low-to-medium-cost, non-reference air quality monitoring sensors (AQM sensors) for the purpose of providing the City with real-time raw and processed air quality monitoring data for particulate matter with diameter size of 2.5 micrometers (PM<sub>2.5</sub>), Nitrogen Dioxide (NO<sub>2</sub>) and meteorological data (e.g. ambient temperature, relative humidity, wind speed, wind direction and rainfall) needed for the baselining and continuous monitoring of ambient air quality within the territorial jurisdiction of Quezon City.

The Project aims to establish, operate and maintain a local air quality monitoring network and develop a monitoring information system to allow real-time sharing of air quality data with the public which are foundational data and information needed to craft the City's Air Quality Management Plan in conformity with the City's international commitments and the Philippine Clean Air Act of 1999. This will also complement, expand, and build upon the activities conducted and implemented under the C40 Air Quality Technical Assistance Programme (C40 AQ TAP) which entails the conduct of a baseline air quality study through the deployment of non-reference AQM sensors and the development of an air quality monitoring network and management plan.

#### **III. PROJECT SCOPE OF WORK**

The following are the minimum activities to be undertaken for this Project:

1. Collaborate with the Quezon City EPWMD regarding the siting requirements and installation of the AQM sensors as well as the development of a Quality Assurance and Quality Check (QA/QC) protocol;

2. Supply, deliver, calibrate and maintain the AQM sensors in accordance with the specifications provided (Annex A – Technical Specifications of the AQM Sensors);
3. Conduct necessary capacity building activities for Quezon City personnel;
4. Provide the following for one (1) year:
  - a) A cloud-based Air Quality Data Acquisition and Handling System (AQ DAHS), with an activated subscription complete with administrator-level account credentials to the Quezon City EPWMD, that is capable of collecting and transmitting continuous, automated, and real-time and averaged data over a given period, with minimum sampling average of 1 minute to 5 minutes for each measured parameter.
  - b) Submit air quality monitoring data for PM<sub>2.5</sub>, NO<sub>2</sub> and meteorological data with at least 75% Data Capture Rate.
  - c) Monthly report disclosing the frequency of maintenance conducted, calibration undertaken, precision test, and corrective measures implemented, among others.
  - d) All operational expenses relative to the operation and maintenance of the AQM sensors, including but not limited to the following expenses: internet/mobile data bills, consumables, etc.;
  - e) Standby and emergency in-house personnel to immediately conduct service maintenance or troubleshoot the AQM sensors to mitigate loss operation time;
  - f) Standby, ready-to-deploy AQM sensors, of the same specification, at the expense of the Service Provider, in times of prolonged downtime of the AQM sensor;
  - g) Minimum of one (1) year warranty period which shall cover removal, replacement, or repair of the low-cost air quality monitoring sensors and accessories;

#### **IV. EXPECTED OUTPUT**

Given the above-mentioned Scope of Work, the Service Provider under this Project is expected to submit the following:

1. Project Inception Report
2. Installation Report
3. Calibration and Accuracy/Precision Report
4. Monthly submission of raw and processed air quality and meteorological data with at least 75% data capture rate, in digital copy format, that has undergone Quality Assurance and Quality Control (QA/QC) protocols

#### **V. PROJECT STANDARDS & REQUIREMENTS**

##### **Minimum Qualifications and Requirements**

###### **Track Record**

1. The Service Provider should have supplied, delivered, calibrated and maintained at least one (1) AQM sensor in the last five (5) years and have operated and maintained similar sensors in the country.
2. The Service Provider should have a single largest similar completed contract within the last three (3) years which must be at least fifty percent (50%) of the Approved Budget for the Contract.

The Service Provider must execute a statement of all its ongoing and completed government and private projects relative to this project as part of the Technical Requirements.

#### Organization

1. The Service Provider must have an in-house service engineer, IT systems software/maintenance personnel in the event of an immediate service-level maintenance to the instrument system, to ensure urgent response to mitigate loss operation time.
2. The Service Provider is preferred to have an office in Metro Manila, or an affiliate office or company that can facilitate coordination for the delivery and installation of instruments and can provide direct technical assistance or stand-by instruments/systems in case of malfunction. If based abroad, the Service Provider should have a local counterpart who will be required to provide information on mechanism for coordination and communication throughout the project; shipping logistics and associated costs, support available for coordination of shipment; and protocols involved in case of malfunction, difficulties in data access, and other issues.

The Service Provider shall submit the complete list of Key Personnel and Support Staff with their corresponding qualifications accompanied/supported with the following documentary requirements as part of the Technical Requirements:

- Original copy or Resume or Bio-data
- Photocopy of Diploma
- Photocopy of Professional License (if applicable)

#### Detailed Work Plan

A Detailed Work Plan shall be submitted by the Service Provider as part of the Technical Requirements. It should contain significant information, necessary resources, timelines, activities and strategies to be undertaken in accomplishing the Project objectives and scope of work.

#### Equipment

The Service Provider shall provide the components for the AQM and meteorological sensor as provided for under Annex A – Technical Specifications of the AQM Sensors of this Terms of Reference.

#### Acceptance Criteria of AQ data

Data Capture Rate must be at 75% or higher for the AQM sensors, for purposes of interpretation, the measured data for each air pollutant must be consistent with the prescribed averaging times under the National Air Quality Guideline Values of the Philippine Clean Air Act.

Acceptable data shall not include irregular data such as negative data, among others. Data accuracy should be calibrated with the Quality Assurance/ Quality Control set by the EPWMD.

### **VI. PROJECT IMPLEMENTATION AND DURATION**

The Service Provider must be able to conduct the necessary consultations with EPWMD, capacity building activities as well as supply, deliver and install the AQM Sensors (*Items 1- 3 of the Project Scope of Work*) by **December 31, 2021**. The other scope of work (*Items 4a-g of the Project Scope of Work*) must be continuously provided for one (1) year after the AQM sensors have been installed.

### **VII. APPROVED BUDGET FOR THE CONTRACT (ABC)**

The Approved Budget for the Contract is **Two Million and Six Hundred Thousand Pesos (PHP 2,600,000.00)** inclusive of all government taxes and other fees.

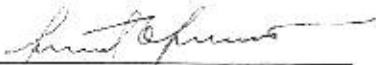
### VIII. CANCELLATION OR TERMINATION OF CONTRACT

The City may, without prejudice to other remedies against the Service Provider, unilaterally cancel or terminate the Contract, in whole or in part, due to default, insolvency or for justifiable cause or on any ground which it deems inimical to the City's or public's interest, which includes but is not limited to the following:

1. Failure of the Service Provider to provide /meet the necessary requirements as stated in this TOR and in other bidding/contract documents;
2. Violation or non-performance of the other terms and conditions of the Contract; and
3. Other acts inimical to public interest.

The guidelines contained in RA 9184 and its revised IRR shall be followed in the termination of any contract. In the event the City terminated the Contract due to default insolvency, or for cause, it may enter into negotiated procurement pursuant to section 53 (d) of RA 9184 and its IRR.

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# ANNEX A – TECHNICAL SPECIFICATIONS OF THE AQM SENSORS

The Service Provider shall provide the following components for the low-to-medium cost, non-reference air quality monitoring sensors. The air quality monitoring instrument/system should be able to measure the following pollutants, whether separate or in simultaneous capacity to measure the pollutants. On the other hand, the meteorological data can be fully separated from the AQM sensors with the specified details:

## 1. AQM SENSORS

### PM<sub>2.5</sub> and NO<sub>2</sub> Sensors (minimum of 12 units)

Pollutant (Mandatory)	Range	Detection Limit	Remarks
Particulate matter with diameter ≤ 2.5 micrometers (PM <sub>2.5</sub> )	0 – 2,000 µg/m <sup>3</sup> (or higher)	1 µg/m <sup>3</sup>	Must have (a) a built-in drier to address effects of humidity (for medium-cost sensors) or (b) documented approaches for correction for environmental variables that influence response in high humidity settings (for low-cost sensors)
Nitrogen dioxide (NO <sub>2</sub> )	0 - 1,000 ppb (0-2,000 µg/m <sup>3</sup> )	5 ppb	-

### Meteorological Sensors (minimum of 5 units)

Meteorological parameters (Mandatory)	Range	Detection Limit
Temperature	-10°C to 50°C	0.1°C
Relative humidity	0% to 100%	1%
Wind speed	0 to 50 m/s	0.1 m/s
Wind direction	0° to 359°	0.5°
Rainfall	-	0.2 mm

The following meteorological parameters can also be part of the monitoring:

Meteorological parameters (Non-mandatory)	Range	Detection Limit
Atmospheric pressure	850 to 1200 mbar	0.1 mbar
Solar radiation	0 to 1400 W/m <sup>2</sup>	1 W/m <sup>2</sup>

The Service Provider should provide documentation of technical and technological specifications which describes the measurement technology or principle for each kind of monitoring instrument/system, together with the measurement range, sensitivity, and accuracy under various environmental conditions. An inventory of all supplies and applicable components for the operation of the instrument/system must also be submitted, including particulars such as, but not limited to, sampling inlet, tubing, and drier systems.

The Service Provider should give details about their planned product update upfront during the procurement process and insist any firmware updates be pre-approved by the City Government project team before they are applied. As a contingency, the Service Provider



should consider keeping a stock of the same type of sensors, keeping in mind the finite shelf life of the said sensors.

## **2. Data acquisition and handling system**

The monitoring system must be capable of collecting and transmitting continuous, automated, and real-time and averaged data over a given period, with minimum sampling average of 1 minute to 5 minutes. The system must also include a prepaid, activated, one (1) year subscription fee at no cost to the City.

For each of the parameters measured, the minimum sampling and averaging period must thus be specified. Averaging periods of 15 minutes, 1 hour, 6 hours, 12 hours, and 24 hours must also be available and stored in the internal memory of the instrument/system and/or transmitted to the data logger or Cloud (other data management details are specified in Section 7).

Each data reading must be with clear time stamps with preferred format of mm/dd/yyyy hh:mm in adjusted coordinated universal time (UTC + 8 or PHT) to reflect Philippine time, otherwise time stamp corrections must be explained and is preferred to be automatically processed in the data management/dashboard system.

## **3. Power requirements**

The electricity requirements or power consumption (average and max in watts) of instrument must be provided. Instrument/system must ideally handle 100 to 240 volts (autovolt). To avoid data losses in case of power interruptions, all monitoring instrument/systems must have a rechargeable lithium or nickel-metal hydride (NiMH) battery system or preferably, a built-in solar power charging unit.

The minimum and maximum battery operating period must be identified, with a minimum of fifteen days operation without main power source or solar power. The charging time of the battery must also be specified, together with the depth of discharge (minimum battery level requiring charge). For equipment with solar power, the solar panel capacity must be provided. Details on the battery specifications, lifetime, and replacement in case of malfunction must also be provided. If available/applicable, describe if the battery and/or power status of each instrument can be checked through an online dashboard or application.

Power (current) consumption and input voltage for the charging must also be specified, with systems complying with international and local safety standards.

## **4. Installation considerations**

Details on the materials, structures, and other requirements for the installation of the monitoring instrument/system must be specified, and the corresponding costs if can be provided by the Service Provider. These may include (but are not limited to) the following:

- Instrument casing/housing, platform (e.g., tower, mast, etc.) and/or other protective structures (preferably weatherproof)
- Tools and consumables needed to secure the instrument/system (e.g. screws, clamps, electrical wires, terminal connectors, insulation, etc.)

## **5. Instrument/system performance, warranty and insurance information**

Average lifetime of each instrument/system must be specified, together with the description of performance based on previous deployments in other locations, most especially in tropical regions in Asia. Narrative reports, copies of scientific journal publications or results of laboratory and field tests (i.e. collocation with reference instruments) must be included as

attachments in the bid submission. The Service Provider must specify if there are systems in place to flag instrument errors to the user (e.g. inform the user if the instrument is still in best performing condition). A performance checklist must be turned over to the end-user for periodic checking.

Warranty/guarantee details for each item provided by the Service Provider must be specified and will be reflected in the Contract. In the case of instrument malfunction within the warranty period, Service Provider must describe process of rapid instrument replacement or repair which when not satisfied, all related costs to continue monitoring will be shouldered by the Service Provider. Insurance information must be elaborated in the documentation, together with the process of ensuring that the necessary provisions from the end of the Service Provider will be met.

All service and/or owner manuals should be provided in soft and hard copies.

## **6. Calibration and maintenance**

Details on the calibration process of the instrument/system must be described as applicable, including information on:

- (a) the quality assurance/quality control (QA/QC) specific steps to ensure good performance of the instrument
- (b) materials needed (e.g. calibration gases, etc.) and the corresponding costs if provided by the Service Provider
- (c) the period it takes to complete the process

For the maintenance procedure, a timeline of maintenance schedule for the duration of the monitoring period must be specified, together with the information (a) to (c) specified above.

## **7. Data storage and Management**

### **Data storage**

Storage of all data collected from the monitoring instrument/system must be explained in the proposal, which can be manual and/or wireless digital (telecommunications or Wi-Fi-based). It is preferred that both systems are present to have a back-up storage in the case of interruptions in direct digital transmission of data, but information on both can be provided by the Service Provider as applicable.

- (a) Manual storage of data within the internal memory of the instrument/system must be described, providing information on storage capacity which should be able to cover minimum two weeks' worth of 15-minute averaged data stored as a .csv file. The software and equipment (e.g. SD memory card, hard drive, USB, or full data management system) needed to manually download the data must be described in the proposal, and provided and quoted for by the Service Provider.
- (b) For wireless or direct transmission of data to a Cloud or to an external data storage (e.g. file transfer protocol (FTP)) system transmitted through telecommunications or Wi-Fi), the Service Provider must identify the necessary requirements and the corresponding costs. These requirements include but are not limited to:
  - Minimum cellular data rate transmission
  - Minimum Wi-Fi bandwidth capacity
  - Operating systems necessary

### **Data QA/QC, display, and visualization**

If available, the Service Provider must provide details and the corresponding costs of access to and use of a data dashboard which will display the raw and processed monitored data, that is available for download by the end-user. Options and costs for customizing the data dashboard must also be presented, together with training on the use of the dashboard.

It is preferred that a real-time error flagging system is in place, such as when the instrument is not collecting data more than 75% data capture rate, which means collecting data less than 75% of the required averaging time per pollutant. The Service Provider must also identify if the data dashboard has an automated capacity to flag extreme values or outliers.

All possible data visualization available must be presented, together with the calculations or processes involved in generating the plots, maps, and other figures. In the case of air quality index (AQI) display, the Service Provider must specify the averaging period used and the reference AQI breakpoints applied.

In the case of Cloud-based instruments/systems which transmit data on a global database, privacy restrictions and data rights must be described in detail.

Project partners should clearly define levels of data quality at the outset and agree on what is acceptable for public release, and with what caveats, at different stages of the project.