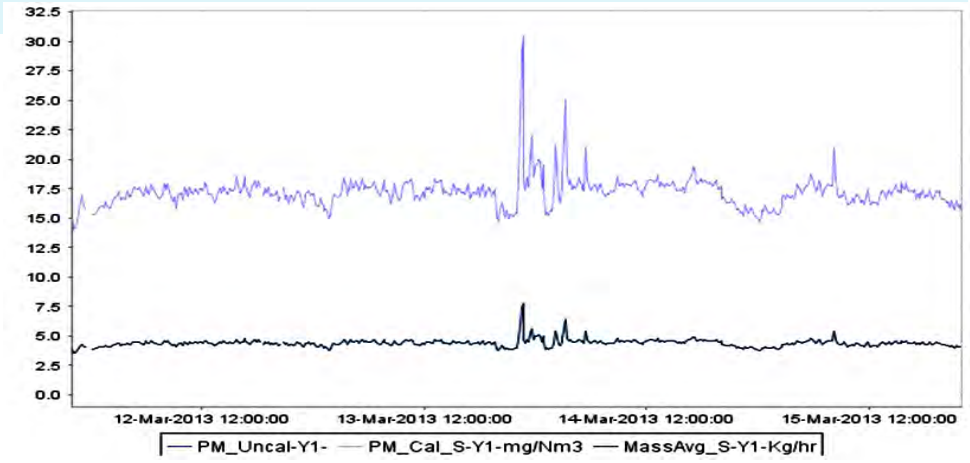
Guidelines for Selection, Installation and Operationof Continuous emissions monitoring Systems

Prepared for Industries participating in the Pilot Emissions Trading Scheme for Particulate Matter from Stationary Sources (Stacks)

Date: 19 November 2013



Ministry of Environment and Forests
GOVERNMENT OF INDIA

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Acknowledgments

We would like to acknowledge the contributions of all members of the Technical Committee in developing these guidelines. We also acknowledge the contributions and peer review provided by Mr. Alan Leonard of Ricardo-AEA (UK). Additional peer review comments were provided by Dr. Laura Diaz Anadon (Harvard University) and Dr. Richard Schmalensee (Massachusetts Institute of Technology).

Thanks are expressed to all concerned Member Secretaries: Mr. J.S. Kamyotra, CPCB; Mr. Hardik Shah, GPCB; Mr. Rajeev Mital, MPCB and Dr. S. Balaji, TNPCB for their support in this endeavour. The efforts of the Technical Committee, led by Dr. D. Saha, Scientist-D & I/c Air Laboratory of CPCB his team are also put on records.

Contents

1. INTRODUCTION

This guidance note describes a set of requirements for industries to streamline the selection, purchase, installation, and operation of CEMS devices. For the details, if required, industry should refer to "Specifications and Guidelines for Continuous Emissions Monitoring System (CEMS) for PM Measurement with Special Reference to Emission Trading Programs." This full specification document is available on the CPCB website and with the SPCBs in case further clarification is needed.

1.1 Role of Continuous Emissions Monitoring Systems for Measurement

The term CEMS refers to the instrumentation and software required to measure emissions from a stationary source on a practically continuous basis. Unlike for carbon dioxide emissions or energy consumption, input-based methods of measurement are not reliable for particulates, since particulate emissions is a complex function of combustion conditions and abatement technology. Emission measurement and monitoring by CEMS has been in practice across the globe since the 1960s.

Different technologies have been developed to make quantitative measurements of particulate matter concentrations or load in smoke stacks. A characteristic that is common to all of these technologies (with the exception of beta attenuation, an extractive method) is that they are based on indirect measurement principles and therefore require *calibration* to smoke stack conditions before use. Thus calibration of a particulate CEMS device is a central part of all performance specifications including this one. This calibration in all cases involves a comparison of the continuous emissions monitoring device to standard gravimetric sampling techniques that are in use all over the world today. In a sense therefore, PM CEMS can be viewed as an extension of existing manual sampling techniques where technology is used to move from a one-time measurement of particulate matter pollutants in the stack, to a continuous measure.

1.2 Pilot for Emissions Trading Scheme in India

Emissions trading systems have been applied to a variety of pollutants around the world in order to guarantee environmental outcomes while minimizing compliance costs. The US EPA pioneered such trading under the Clean Air Act to limit a variety of common air pollutants. Following this example, environmental trading programs have proliferated in the European Union, Canada and, increasingly, developing Asia. In India, environmental markets are in their early stages, with small Renewable Energy Certificates and carbon offset markets in existence. Emissions trading, however, is yet to be used in environmental regulation.

In this context, the Ministry of Environment and Forests has initiated an important project to design and evaluate a pilot emissions trading scheme (ETS) for particulate matter from stationary sources, in collaboration with three states – Gujarat, Maharashtra and Tamil Nadu, with the Central Pollution Control Board as nodal agency for overall implementation of the program. This has been initiated as a way forward towards reduction of Particulates in the ambient air. Therefore, the role of CEMS is to measure the total load of particulate matter (PM) coming from each stationary source. Total emissions can then be reconciled against permit holdings in the trading scheme.

1.3 The Role of Different Parties in a Monitoring Regime

The monitoring regime proposed is based upon CEMS but not limited to the instrumentation itself; rather, it encompasses a complete institutional and technical system for ensuring high-quality emissions data.

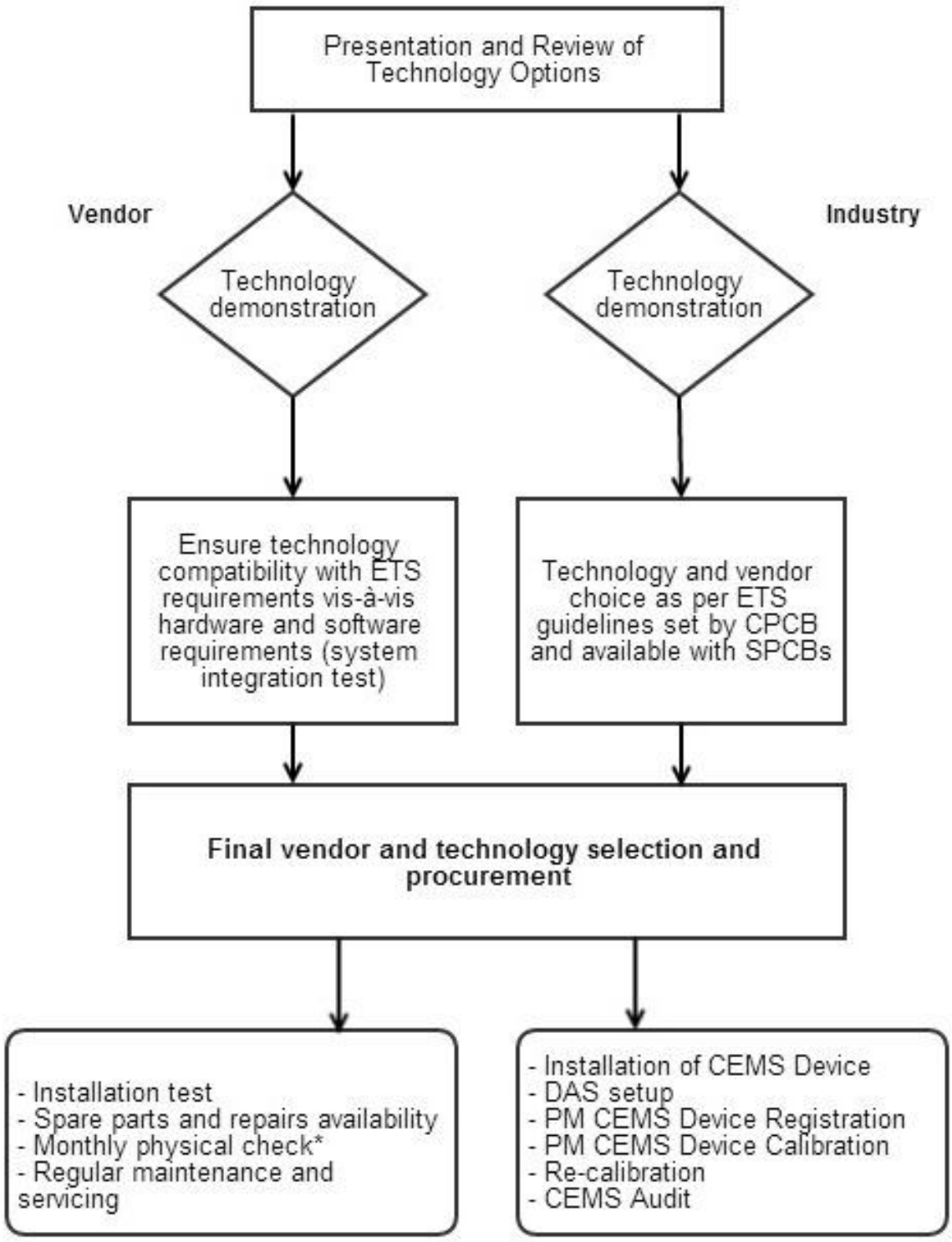
For successful implementation of the programme, most responsibilities have been entrusted to the pilot participating industries and SPCBs, with a view to guide the technical issues involved in this programme, including monitoring and reporting requirements outlined in this document along with related specification documents. The industry may employ CEMS vendors to install, calibrate and help maintain a monitoring system suitable for its characteristics as an emissions source. The industry alone remains accountable for ensuring the performance of CEMS, documenting that performance through calibration, and sending quality data to the SPCBs concerned.

The SPCBs will oversee the monitoring regime, record and validate emissions data from CEMS and use that data to implement the pilot emissions trading scheme. The SPCBs may intervene in the monitoring of a particular industry as they see fit to keep data quality high. They may also coordinate the supporting roles of third parties such as accredited labs, CEMS vendors and CEMS working groups in each industrial cluster.

1.4 PM CEMS Standard Operating Procedures

The standard operating procedures (SOPs) for the selection, installation, calibration, and maintenance of PM CEMS devices underpin the functioning of the whole system. These procedures form the linkages between responsibilities of the various stakeholders and the specifications and standards required for smooth implementation of the monitoring framework for ETS. Therefore, this document provides a detailed list of the procedures that apply to industry stakeholders and guidelines for each required step.

1.5 Overview Flow Chart for PM-CEMS Selection



2. INDUSTRY GUIDELINES FOR SELECTION AND OPERATION OF CEMS

The objective of industries is to have a PM CEMS device installed on an appropriate stack, and send continuous PM mass flow data to the concerned Pollution Control Board (PCB) on a real-time basis, and according to the ETS program guidelines.

Following steps would be required to reach the objective:-

1. Meet PM CEMS Vendors
2. PM CEMS Device Selection
   - 2.1. Select PM CEMS Technology
   - 2.2. Select PM CEMS Vendor (including compatibility check as mentioned in section 4.4.1 below)
3. Install CEMS
4. Set-up Data Transfer System
   - 4.1. Hardware Set-up
     - 4.1.1. Set up DAS (Data Acquisition System - PC with internet connection at the industry)
     - 4.1.2. Lay cable from CEMS device to DAS
     - 4.1.3. Data logger
   - 4.2. Get user ID & password from SPCB
   - 4.3. Registration of CEMS installed
   - 4.4. Software Set-up
     - 4.4.1. Installing 2 software programs (CEMS Software & ETS Bridge Software)
     - 4.4.2. Set Configuration of the CEMS Software
5. Calibration of PM CEMS device and Performance Test
   - 5.1. Iso-kinetic Sampling for Calibration of PM CEMS
   - 5.2. Post-Calibration Performance Test
6. Operations and Maintenance
   - 6.1. Regular Maintenance
   - 6.2. Monthly zero check
   - 6.3. Re-calibration
   - 6.4. CEMS Audit

Step 1: Meet PM CEMS Vendors

Industry should meet PM CEMS vendors to understand and discuss the measurement technologies suitable for their stacks, PM CEMS models, costing, delivery terms and service terms.

Step 2: PM CEMS Device Selection

For ETS, each industry will need to select the appropriate PM CEMS device, a process which consists of selection of both the appropriate technology and the vendor. Further detail on each of these steps follows.

Step 2.1: Select PM CEMS Technology

PM CEMS should be able to measure and report PM emission mass flow (in kg/hour). This can be achieved by either of following configurations:

1) Installing PM CEMS which measures PM mass flow directly (e.g. DC Triboelectric). This is called Type of Configuration (ToC)=1.
2) Installing a PM CEMS concentration device and a flow meter device. This is called Type of Configuration (ToC)=2.

Configuration check / suitability check:

a) Suitability of a CEMS device depends on stack characteristics, process parameters, and air pollution control devices (APCDs) installed. The following selection matrix may be used for selecting the CEMS device:

Parameter	DC Tribo Mass Flow Monitor	AC Tribo Mass Concentration Monitor	Electrodynamic	Light Scatter Technology	Opacity Monitor	Wet Extractive Technology
Measured Value	Direct in g/s, kg/hr	mg/m^3	mg/m^3	mg/m^3	mg/m^3	mg/m^3
Velocity Monitor Required	X	✓	✓	✓	✓	✓
Duct < 1m Diameter	✓	✓	✓	✓	X	✓*
Duct >1m to 4m Diameter	✓	✓	✓	✓	✓	✓*
Duct > 4m Diameter	X	X	X	X	✓	✓*
Electrostatic Precipitator	X	X	X	✓	✓	✓
Stack Gas Temperature > 500^oC	✓***	✓***	✓***	✓	✓	✓
Wet Scrubber with Stack Temperature $<70^oC$ or water condensate present	X	X	X	X	X	✓
Large particles> 20um	✓	✓	✓	X	✓	X
Dust> 100 mg/m^3	✓	✓	✓	✓****	✓	X
Varying gas velocity	✓^	X	✓	✓	✓	✓**

* Although this technology will work on any duct diameter, the size of the sampling nozzle diameter in relation to the duct diameter means that the sample is very unlikely to be representative of the particle size distribution of the whole area. This technology is only used where others cannot be used, primarily wet stacks.

** This technology is only appropriate in slowly varying velocity conditions

*** At high temperatures only specially designed instruments such as ceramic body probes will be suitable

**** Scatter light principle can measure readings up to 300 mg/m^3

^ Requires a monitor with mass response that is velocity independent within the range of stack velocity. Recommended for settings with limited velocity variation.

It is crucial to note that only quantitative CEMS designed to measure emissions are recommended for the ETS program, and qualitative / indicative technologies—such as Broken Bag Detectors—cannot be used as a substitute.

b) Flow meter selection matrix:

Type	Impact Differential Pressure (Pitot Tube)		Thermal anemometer [1]	Bi-directional ultrasonic	Infrared correlation
	Single point	Multiport			
Irregular Flow	X	✓	✓[2]	✓[2]	✓
Max Flue Gas Temperature	Up to 550°C	Up to 550°C	200 – 300°C (model specific)	450° C - 850 °C (model specific)	Up to 1000°C
Wet stack	X	X	X	✓	✓
Low speed	X (minimum 5 m/s)		✓	✓	1 m/s – 50m/s
High Speed	✓	✓	✓	Up to 40 m/s (model specific)	1 m/s – 50m/s
Calibration	Factory / Site	Factory / Site	Factory / Site [3]	Factory / Site	Factory / Site

[1] Pressure Transmitter (PT) and Temperature Transmitter (TT) are not installed with a Thermal Anemometer as it directly measures Mass Flow which is usually the required quantity. However, for the purpose of ETS in Type 2 CEMS configuration, Volumetric Flow is required and hence PT and TT are necessary to calculate density and convert mass flow calculated by the anemometer to volumetric flow.

[2] Can be accounted for by using multiple probes/sensors

[3] Calibration depends on physical properties (thermal conductivity, specific heat) of the gas whose flow is to be measured. Thus variation in properties of stack gas from factory calibrated values can result in inaccurate measurement.

Step 2.2: Select PM CEMS Vendor

Once the suitable PM CEMS technology and flow measurement device (if applicable) is identified, industries must select a vendor who can supply the device. After placement of a purchase order, it can take up to 1 month to procure the device. Industries are highly encouraged to engage in a specialized contract with the vendor stipulating the terms and responsibilities of each party.

Before selecting a vendor, industry should keep following points into consideration (select a vendor fulfilling following requirement):-

1. Hardware

1.1. PM CEMS device and flow-meter should be tamper proof as far as possible
1.2. PM CEMS device should ideally measure and report both the **calibrated and uncalibrated** data to the DAS if possible. For devices which cannot send uncalibrated data, the device should register a calibration factor of '1' and the calibration settings should be password protected.
1.3. PM CEMS devices and flow meter should be as per the Physical Accuracy Requirement[2]
1.4. CEMS Hardware Certification**:** The PM CEMS device and flow meter should also have test results / certification /conformance from an accredited agency or a

[2] See Appendix A1.1 Physical Accuracy Requirement of CEMS Device

recognized standard viz. US EPA PS-11, MCERTS or TUV covering basic operational and technical principles.[3]

1.5. In addition to the above it is strongly recommended that automatic zero and span check facility be present in the CEMS hardware device. In the absence of such, it is required to carry out these checks on a weekly basis to ensure instrument performance.

2. Software

2.1. Vendor should have ETS compatible software, i.e., it should be able to send data in the prescribed format and should pass the System Integration Test for CEMS Vendor Software. Details in Step 4.

3. System Integration

3.1. Vendor should install hardware and required software, integrate the whole system (Step 4), calibrate the device (Step 5) and make the real-time data transfer to the SPCB server possible.

4. Performance of the CEMS

4.1. Calibrated data from CEMS must meet performance requirements in order to be deemed eligible for the ETS program. **Vendor should take responsibility that the device installed passes the Post-Calibration Performance Test**. It is recommended that industries withhold payment to the vendor until the device passes this test. Details in Step 5.

5. Operations and Maintenance

5.1. Vendor should provide maintenance support (AMC)
5.2. Vendor should provide spare parts of the device

Step 3: Install CEMS

Installation ports for PM CEMS and flow meter should be selected keeping following aspects into account:-

1. **Laminar flow**: Installation Point for the PM CEMS and flow meter should be such that flow is laminar at that point. As a general rule, the port hole should be at least **five stack diameters downstream** and **two diameters upstream** from any flow disturbance such as a bend, expansion, or contraction in the stack.[4]
2. **Accessibility for Maintenance**: Device should be installed such that it is accessible for regular maintenance.

Industry should provide the ports (flanges if requested) on the stack as requested by the CEMS vendor for installation.

[3] At present US EPA has no device-specific certification for PM CEMS. However instrument manufacturers can declare conformance against the PS-11 standard.
[4] For details refer to Appendix B Installation and Maintenance Guidelines of the full CEMS specifications document

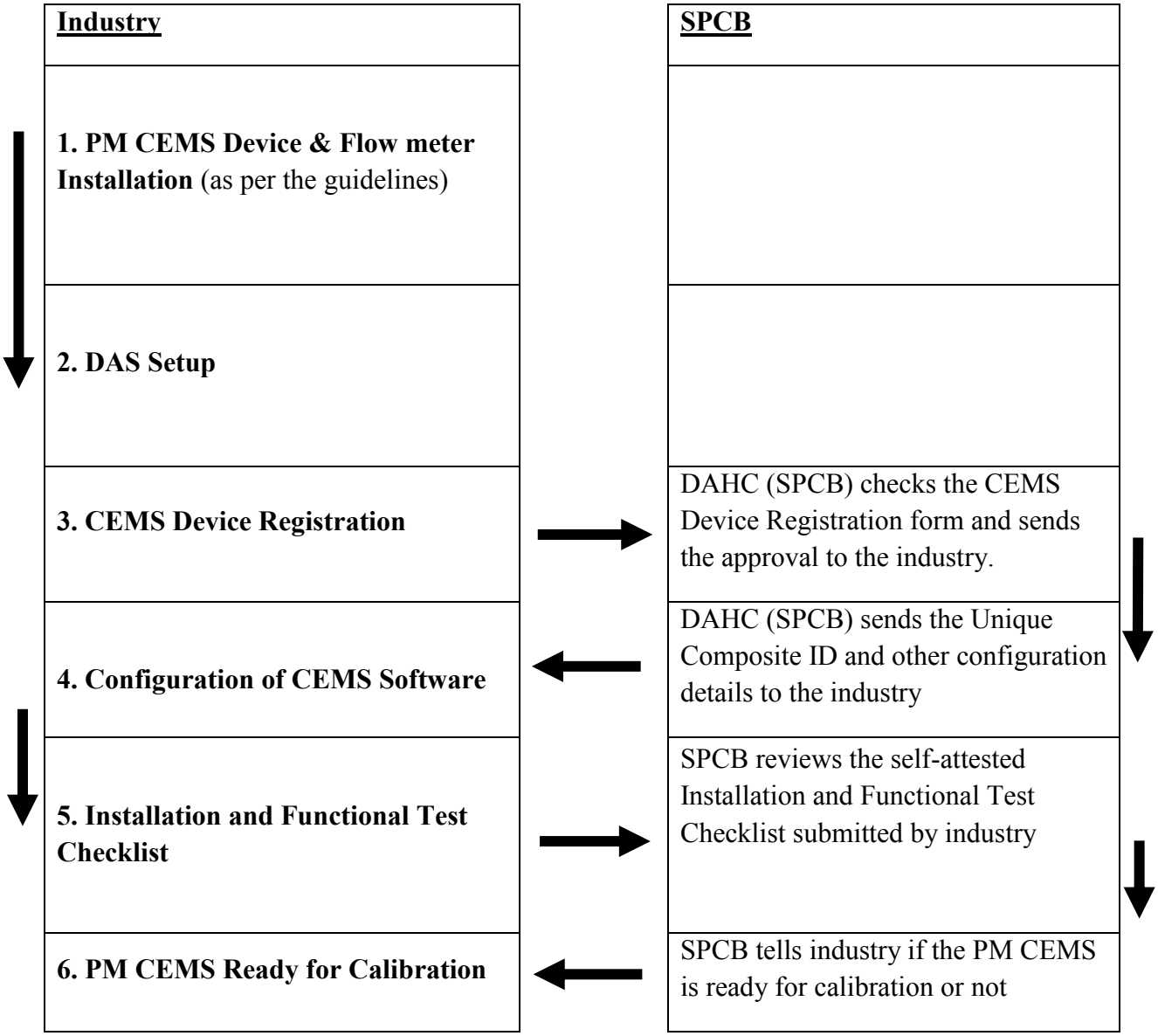
Additional installation guidelines such as selecting the measurement plane and mounting location are provided in the full CEMS specifications document.

Step 4: Set-up Data Transfer System

Setting-up the data transfer system involves following 4 activities:-

- Step 4.1: Hardware Set-up
- Step 4.2: Getting user id and password from SPCB
- Step 4.3: Registration of CEMS installed
- Step 4.4: Software Set-up

The following flowchart describes the order of these activities:



Step 4.1: Hardware Set-up

Hardware set-up consists of following 2 requirements:-

- Step 4.1.1: Set-up DAS
- Step 4.1.2: Install data logger

Step 4.1.1: Set-up DAS (Data Acquisition System)

The hardware for a DAS must be set up to allow for data transfer from CEMS to the SPCB on a continuous basis.

It should have:-

- **A dedicated PC on site[5].** This PC is referred to as the Data Acquisition System (DAS) and will consist of CEMS Vendor software for data acquisition from the device, and "ETS bridge software" for sending data in the prescribed format to the SPCB (see Step 4.4).
- **Fast and reliable internet connection** (dedicated broadband internet connection, min 256Kbps). This would facilitate real-time data transfer.

Step 4.1.2: Data logger

Industry should ensure that the vendor installs a data logger to provide a temporary backup in case of computer failure. Data logger should be able to store data for at least a month.

Step 4.2: Get user id & password from SPCB

A web-based application will be made available to industries for viewing CEMS data and conducting administrative procedures.

In order to access the web-based system, industry is required to have a User ID and password. To obtain this, the industry will submit a "User ID Request Form" to the designated officer at SPCB (a signed form must be submitted manually, not electronically).[6]

After receiving the form, the designated SPCB officer will email a user ID and password to the industry's key contact person, after which the industry can begin accessing the web-based application.

Step 4.3: Registration of CEMS installed

Industry will have to fill up and submit CEMS Registration forms for each CEMS device installed at the industry. The forms will be made available to industry through the web based application. SPCB will generate a Composite ID for each CEMS device that is registered and communicate it to industry. Following registration, industries are required to submit installation and functional checklists to the SPCB through the web based application. The checklists are designed to ensure that the CEMS device was installed properly and according to standard procedures and is functioning at an optimal level. This activity should be done in close coordination with the vendors as vendors would be filling in the installation checklist and functional checklist.

[5] The Data Transmission System for Online Real-time Continuous Monitoring System shall ensure that the data being transmitted are non-editable & non-modifiable and that the system should be tamper-proof and that the system shall be certified by the supplier for the same.
[6] See Appendix A2.1 User ID Request Form

Step 4.4: Software Set-up

Software Set-up has following 2 activities:-

- Step 4.4.1: Installing software (CEMS Software and ETS Bridge Software)
- Step 4.4.2: Configuring the CEMS Software

Step 4.4.1: Installing software (CEMS Software & ETS Bridge Software)

The software requirements for industry are two-fold:

1. CEMS software
2. ETS bridge software

Additionally, a web-based application will be made available for industries to view emissions data.

CEMS Software: CEMS software is designed by the vendor (or a third-party) to accept and convert CEMS data into a standard format as per ETS guidelines. It will be installed on the DAS (industry PC) and will output the prescribed parameters per ETS guidelines.

As discussed in "Step 2.2: Select PM CEMS Vendor", **industry should make sure that the vendor has ETS Compatible CEMS software** and has passed the System Integration Test for the CEMS Software.

ETS Bridge Software: The ETS bridge software is designed by the ETS team and is available for free download. The CEMS software prepares data in a standard format, which, ETS Bridge Software reads and sends to SPCB server on a continuous basis.

Step 4.4.2: Set Configuration of the CEMS software

Through Step 4.3, each CEMS device in the industry will get a unique composite ID. Vendor should set the composite ID in CEMS Software and initiate data transfer from CEMS device to SPCB server.

Step 5: Calibration of PM CEMS device and POST CALIBRATION Performance Test

Step 5.1: Iso-kinetic sampling for Calibration of PM CEMS

Although industries will not calibrate the PM CEMS device themselves, it is important that they oversee the calibration process and ensure it is in accordance with the protocol stipulated in the ETS program guidelines. Calibration of PM CEMS device is performed using iso-kinetic sampling for PM emission measurement as the Standard Reference Method.

Following points should be taken into account for iso-kinetic sampling:

- Select a lab to carry out iso-kinetic sampling for calibration of CEMS. Only the following labs are authorized to conduct PM sampling:
    - NABL certified labs
    - MoEF accredited EIA lab
    - Labs otherwise approved by CPCB/SPCB

- PM samples taken for calibration should be done in accordance with any one of the approved iso-kinetic sampling methods:
    - CPCB Publications: Emission Regulation – Part III and "Guidelines on Methodologies for Source Emission Monitoring" (2013)
    - EPA method 17
    - EPA method 5
- The number of PM samples required will depend on whether a given industry has the ability to vary emission levels through means such as variation of load, feed rate, turning off ESP cells, or other methods.

- The industry is recommended to obtain a minimum of 9 measurements for calibration with variation in the emission levels as follows (7 isokinetic samples excluding 0 load):
    - 2 points at zero load (no load)
    - 4 points in the 75-100% emission range
    - 3 points in the 25-75% emission range

- However in situations where above mentioned scenario is not possible or very difficult, 6 measurements as per the following load variation will suffice (4 isokinetic samples excluding 0 load):
    - 2 points at zero load (no load)
    - 4 points at 75% - 100% emission range

- For a given PM sample to be considered valid for calibration there are three primary criteria that should be met. Industry has responsibility for submitting the results of the iso-kinetic sampling to the SPCB and should request additional samples to be taken by the environmental laboratory if these conditions are not met:
    - Isokineticity value between 90% and 110%
    - Data availability from CEMS device corresponding to the isokinetic sampling duration is at least 95%
    - Normalized volumetric flow measured during iso-kinetic sampling is in $\pm$ 20% of the average normalized volumetric flow meter reading during sampling (Applicable for ToC=2 and not ToC=1)

Once the required number of **valid** samples has been taken, using the web-based application, industry should submit the results of the iso-kinetic sampling to the SPCB server. SPCB will calculate calibration factors for each CEMS device and perform Post Calibration Performance Test.

Step 5.2: Post-Calibration Performance Test

The CEMS must pass Post-Calibration Performance Test in order to be deemed eligible for ETS. Results of Calibration and Post Calibration Performance Test will be communicated to industry by SPCB through the web based application.

If an industry passes a Post-Calibration Performance Test, instrument is deemed eligible for ETS and ready for operation. Otherwise, industry should contact vendor and depending on the situation, either isokinetic sampling should be performed again or device should be replaced.

As discussed in "Step 2.2: Select PM CEMS Vendors", industry should make sure that **vendor should take the responsibility that the installed device passes the Post-Calibration Performance Test** and payment should be made once the device passes this test.

Step 5.3: Calibration of Flow Meter

If the industry has selected a technology configuration that also requires installation of a flow meter, industry should ensure that the flow meter is factory calibrated. However, after flow meter installation, industries can cross-check the reading against the standard reference method of flow measurement (manual method). Measurement of flow during the calibration process of the PM CEMS can also be used to cross-check the flow meter calibration.

Step 6: Operations and Maintenance

Step 6.1: Regular Maintenance

Industry should carry out regular preventive maintenance of the device. Industry should obtain the maintenance manual of the device from vendor and perform the maintenance accordingly. Industry may opt for an Annual Maintenance Contract for correct operation of the device.[7]

Step 6.2: Monthly Zero Check

Zero check of the device should be done and adjusted at least once a month. This frequency can change depending on the device and vendor.

Step 6.3: Re-calibration

There are certain situations where a re-calibration of CEMS is required, necessitating isokinetic sampling again (elaborated in the table below). Industries are responsible for overseeing any CEMS re-calibrations and ensuring it is carried out according to the protocol described below.

Industry should recalibrate the PM CEMS device every 6 months. The frequency of calibration of PM CEMS device is subject to change based on the on-field performance of the device.

Recalibration of CEMS is of two types: A and B.

Type A Re-calibration: In this case previous samples can be considered for the Calibration and Post-Calibration Performance Tests.

Type B Re-calibration: In this case previous samples cannot be considered for the Calibration and Post-Calibration Performance Tests. All the iso-kinetic samples taken should be new.

[7] Details on the suggested preventive maintenance are discussed in Appendix A3.1 Preventive Maintenance of PM CEMS Device and Flow-meter

The table below describes situations triggering both types of recalibration events.

Situation	**Type of Re-calibration**	**Remarks**
PM CEMS device operating out of range. This is defined as either: • 10% or more, of the 45-minute-moving average of calibrated CEMS device output, in a week are outside the Valid Calibration Range for five weeks or more. • 40% or more, of the 45-minute-moving average of calibrated CEMS device output, in a week are outside the Valid Calibration Range for one week or more.	Type A	1) Industry should take at least 2 more iso-kinetic samples above the valid calibration range. 2) Calibrate and conduct Post-Calibration Performance Test of the PM CEMS device with the previous sampling points and new sampling points according to ETS guidelines
PM CEMS device (hardware) changed but the model and manufacturer are same	Type B	Calibrate and conduct Post-Calibration Performance Test of the PM CEMS device according to ETS guidelines
Recalibration after every 6 months	Type B	Same as above
Change in fuel or process	Type B	Same as above
Major changes in the APCD which might change the profile of the PM emissions or flow	Type B	Same as above
Failure in a CEMS audit	Type B	Same as above. However, some or all samples taken for the CEMS Audit Performance Test can be used for recalibration

Step 6.4: CEMS Audit

To protect the integrity of emissions data underpinning the pilot emissions trading program, the PM CEMS Device requires ongoing maintenance and quality control. For this pilot, **a CEMS Audit must be performed at least once in a year.** The industry is responsible for overseeing CEMS audit.

CEMS audit steps are outlined in the table below:

Step 1	**Functional Test Checklist:** CEMS vendor performs functional test and submits checklist to industry operator. The components of the functional test are: a. Visual inspection b. Leak testing c. Zero and span check d. Serviceability
Step 2	Industry enters functional test checklist information into corresponding form on the web based user interface of DAHC Server Software and submits it to the DAHC Server at SPCB. Staff from SPCB will review the checklist and send confirmation to industry.
Step 3	**Iso-kinetic Sampling:** Environmental lab will take 4-6 iso-kinetic samples following Standard Reference Method procedures
Step 4	**CEMS Audit Performance Test:** Using the same calibration equation derived for the initial calibration and Post-Calibration Performance Test, the CEMS Audit Performance Test is performed using the iso-kinetic sampling data as the standard reference method for at least 4 sample points at different load conditions. After industry submits the iso-kinetic sampling data to SPCB using the ETS Bridge Software, the DAHC Server Software does the CEMS Audit Performance Test and informs the industry. In case an instrument fails the CEMS Audit Performance Test, the industry has to recalibrate the device with sample points at different load conditions. If an instrument passes the test, 4 points used for doing the CEMS Audit Performance Test can be used for the purpose of calibration. The CEMS Audit performance test is based on a criterion similar to the post-calibration test i.e. it is an RMSPE test.

APPENDIX A1.1 PHYSICAL ACCURACY REQUIREMENT OF CEMS DEVICE

Industries must also ensure the device contains specifications of key operating parameters such as: physical accuracy, response time, minimum detection limit (for flow meters). The following table provides guidance on the key operating parameters to conform for PM CEMS and flow meters:

Name of Parameter	**Specifications**	
	PM CEMS Device	**Flow Meter**
Measurement range	User defined	User Defined
Instrument detectable concentration	10 mg/Nm^3 or less	1 m/s (minimum detectable limit)
Data acquisition	1 minute	1 minute
Data transmission	1 minute	1 minute
Deviation in the raw	< 5% of measurement	<2% of measurement range
Drift	< 1% per month	Overall zero & span drift should be <
Power supply	220 +/- 10 V at 50 Hz	
Data Availability	90% or higher under	90% or higher under normal operation

In addition to the above it is strongly recommended that automatic zero and span check facility be present in the CEMS hardware device. In the absence of such, it is required to carry out these checks on a weekly basis to ensure instrument performance.

Apart from above said requirements of the CEMS hardware, the PM CEMS device and flow meter should also have test results / certification /conformance from an accredited agency or a recognized standard viz. US EPA PS-11, MCERTS or TUV covering basic operational and technical principles.[8]

[8] At present US EPA has no device-specific certification for PM CEMS. However instrument manufacturers can declare conformance against the PS-11 standard.

APPENDIX A2.1 USER ID REQUEST FORM

To be submitted to designated SPCB officer

Industry name: ……

Industry Address: ……

……

……

……

Key contact person from the industry

Name: ……

Designation: ……

Contact number: ……

Email address: ……

Fax: ……

Date: ……

Signature: ……

Industry's stamp:

APPENDIX A3.1 PREVENTIVE MAINTENANCE GUIDELINES FOR PM CEMS DEVICE AND FLOW-METER

In general, maintenance interval of any instrument depends on

- The nature of the measured medium
- The conditions relating to pressure
- General ambient conditions (e.g. climatic conditions at the point of measurement)

PM CEMS – Transmissiometry Type

Components	Preventative Maintenance
Instrument Air	• Check the instrument air is passing or not at the receiver and transmitter side • Instrument Air should be free from Dust, Water vapor and Oil Mist. • If any air filters or regulators connected to the air-line must be drained regularly.
Transmitter & Receiver	• Remove the Transmitter from the flange and Check whether Laser /LED is emitting from the Transmitter. • Check whether any dust particles are deposited on the glass window of the Transmitter or not. • Clean the Dust on the glass window with soft cloth or IPA solution so that all the dust is removed from the glass window. (Note: Care should be taken not to form any scratches on the glass window.) • After cleaning the Transmitter unit aligns the instrument back. The light should 100% pass to the opposite side (Receiver unit).
Zero and Span Check	• Perform the Zero Check of the device • Perform the Span Check of the device
Maintenance Alarms	• Check the maintenance alarms of the device for contamination, misalignment or any other maintenance check
Others	• Visual Inspection and Cleaning of the External Device Parts (external changes such as corrosion, damaged seals and gaskets, colour alterations on the housings, etc.) • Inspection and check of catches, locks and screw connections

PM CEMS – Scatter-light Type

Components	Preventative Maintenance
Instrument Air	• Check the instrument air is passing or not at the receiver and transmitter side • Instrument Air should be free from Dust, Water vapor and Oil Mist. • If any air filters or regulators connected to the air-line must be drained regularly.
Transmitter & Receiver	• Remove the Transmitter/Receiver from the flange • Check whether any dust particles are deposited on the optics or not. • Clean the Dust on the glass window with soft cloth or IPA solution so that all the dust is removed from the sensor. (Note: Care should be taken not to form any scratches on the sensor)
Maintenance Alarms	• Check the maintenance alarms of the device if any.
Others	• Visual Inspection and Cleaning of the External Device Parts (external changes such as corrosion, damaged seals and gaskets, colour alterations on the housings, etc.) • Inspection and check of catches, locks and screw connections

PM CEMS – Triboelectric and Electrodynamic Type

Components	Preventative Maintenance
Cleaning	• Regular Cleaning of Probe • Regular cleaning of insulator • Cleaning of stub pipe • To be done once in 3 months
Drift Check	• To be done 6 month drift check
Maintenance Alarms	• Check the maintenance alarms of the device if any
Others	• Visual Inspection and Cleaning of the External Device Parts (external changes such as corrosion, damaged seals and gaskets, colour alterations on the housings, etc.) • Inspection and check of catches, locks and screw connections

Flow meter – Cross-duct Type

Components	Preventative Maintenance
Instrument Air	• Check the instrument air is passing or not at the receiver and transmitter side • Instrument Air should be free from Dust, Water vapor and Oil Mist. • If any air filters or regulators connected to the air-line must be drained regularly.
Transmitter & Receiver	• Remove the Transmitter & Receiver from the flange • Check whether any dust particles are deposited on the transducer or not. • Clean the Dust on the glass window with soft cloth or IPA solution so that all the dust is removed from the sensor. (Note: Care should be taken not to form any scratches on the sensor.)
Maintenance Alarms	• Check the maintenance alarms of the device for contamination, misalignment or any other maintenance check
Others	• Visual Inspection and Cleaning of the External Device Parts (external changes such as corrosion, damaged seals and gaskets, colour alterations on the housings, etc.) • Inspection and check of catches, locks and screw connections

Flow meter – Probe Type

Components	Preventative Maintenance
Cleaning	• Regular Cleaning of Probe • Regular cleaning of insulator • Cleaning of stub pipe • To be done once in 3 months
Maintenance Alarms	• Check the maintenance alarms of the device if any
Others	• Visual Inspection and Cleaning of the External Device Parts (external changes such as corrosion, damaged seals and gaskets, colour alterations on the housings, etc.) • Inspection and check of catches, locks and screw connections

APPENDIX A4.1: SAMPLE CONTRACT BETWEEN INDUSTRY AND VENDOR

***DISCLAIMER**: The following vendor contract is in initial draft form and is subject to change upon further discussion with CEMS vendors.

SAMPLE PM CEMS ANALYSER CONTRACT

[Insert name of Industry]

And

[Insert PM CEMS Analyser Vendor's full legal name]

AGREEMENT

Relating to the Supply of [Inset PM CEMS Analyser Name]

THIS AGREEMENT is made on the [Enter number for day; e.g. 1st, 2nd etc.] day of [Select Month], [Select Year] BETWEEN:

[Insert name of Industry], of [Address] ("the Customer");

And

[Insert PM CEMS Analyser Vendor's full legal name], of [Vendor's Address] ("the Supplier")

("the Parties").

IT IS HEREBY AGREED THAT:

1. The Supplier shall sell and the Customer shall purchase in accordance with this Agreement

2. The price of the Analysers shall be the price stipulated in the contract after agreement between the parties. For the purposes of this Agreement, the Customer's Contact is [insert contact name] of [insert contact address]; the Supplier's Contact is [Supplier contact name] of [Supplier contact address].

3. This Agreement is governed by the terms and conditions as set out in this agreement and schedule A

4. This Agreement shall take effect on the date of this Agreement ("the Effective Date") and shall expire on [insert date], unless it is otherwise terminated in accordance with

the provisions of this Agreement or otherwise lawfully terminated or otherwise lawfully extended as agreed between the Parties. ("the Term").

The Customer reserves the right to extend the Term for a period or periods of up to [INSERT NUMBER] months with a maximum of [NUMBER] such extensions permitted subject to its obligation at law.

SIGNED for and on behalf of the Customer SIGNED for and on behalf of the Supplier

_____ _____

(being a duly authorised officer)

Witness Witness

Schedule A: Terms and Conditions

1 – Procurement

i. The Supplier shall be responsible for correctly examining conditions at the industry site and supplying appropriate Analyser. In the case that Analyser is found to be inappropriate for the industry site, Supplier shall reimburse the Customer in full.

ii. The Supplier shall only supply the CEMS technologies stipulated in the ETS CEMS guidelines.

iii. The Supplier shall be responsible for ensuring that the Analyser is properly installed and calibrated at the industry site. The Supplier shall be responsible for identifying measurement plane and mounting locations as per ETS CEMS guidelines

iv. The Supplier shall be responsible for making sure the Analyser clears the Post-Calibration Performance Test as set by the regulator specified in the ETS CEMS guidelines at the time of installation and calibration.

v. Customer must fill the installation checklist available on the ETS Bridge attesting to the completion of all installation related activities. A functional test (as per ETS CEMS guidelines) shall be carried out upon installation of CEMS by the Supplier. Supplier is required to understand the necessary procedures and describe to industry where needed in filling out the appropriate installation and functional checklist form.

vi. Both the Supplier and Customer shall be responsible for ensuring that the Analyser clears CEMS Audit Performance Test at a later date.

vii. The supplier shall ensure the device warranty and industry shall ensure maintenance of optimum operating conditions according to the CEMS device.

viii. Supplier shall be responsible for providing accompanying CEMS software which meets the requirements of the ETS guidelines, and this is to be installed on the industry PC and tested for [NUMBER] days. The CEMS Software should pass the System Integration Test.

2 – Warrantee Period

I. The warrantee period shall be calculated from the date of delivery to the date [number] months thereafter.

II. The Supplier is required to carry out all jobs mentioned in subsection "3 – maintenance (II)" free of cost during the warrantee period (or an extended warrantee period if selected by the customer).

III. In cases of faulty design or installation, the Supplier shall replace the system free of cost within [number] months after the need for replacement has been established.

IV. Upon expiration of the warrantee period, the Customer shall have the option of extending the warrantee by a maximum of [number] months contingent on paying [Number] Rupees per month (inclusive of all taxes).

3 – Maintenance

I. Upon expiration of the warrantee period, the Customer shall have the option of entering into a maintenance contract contingent on paying [Number] Rupees per year (inclusive of all taxes).

II. The Supplier shall carry out all jobs mentioned below during the maintenance period:

a. Complete testing, cleaning, and alignments of Analyser monthly to ensure correct physical installation and re-calibration of Analyser once every six months after analyser is installed at site.

b. Preventive maintenance, servicing, and corrective maintenance of Analysers once every three months after analyser is installed at site.

c. In case of breakdowns/major faults in Analyser – precisely identify the cause of breakdown/faults and precisely identify faulty hardware or software (as the

case maybe) that need to be repaired or replaced to make the system operational again.

d. Submit testing and calibration report for every visit.

e. Visit the site at the earliest – within 24 hours of any complaint lodged by the Customer.

f. Provide troubleshooting and calibration related training to Customer's technical staff and Engineers.

III. Payment during the maintenance will be made as per actual work done only.

IV. Customer shall pay for all the spare parts that require replacement after the warrantee period has expired. If the Customer has a maintenance contract with the Supplier, the latter will offer price list for the recommended spares.