Guidance Note for Selection of PM CEMS Device

Prepared for industries participating in the pilot Emissions Trading Scheme (ETS) for Particulate Matter from Stationary Sources

1.0 Scope

This guidance note describes a set of requirements for industries to streamline the selection of CEMS devices for the Emissions Trading Scheme (ETS) pilot project. Its purpose is to briefly describe the key points for industry to consider when selecting and purchasing a CEMS device from a vendor. This document is a sub-set of the larger *Industry Guidelines for Selection, Installation, and Operations of CEMS*, which provides detailed information about installation, system set-up, and calibration of the devices.

2.0 Type of PM CEMS Technologies

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. **The PM CEMS must measure and report PM emission mass flow (in kg/hour).** This can be achieved by either of following techniques:

1) PM CEMS which measures PM mass flow directly (e.g. DC Triboelectric)
2) PM CEMS concentration device and a flow meter device. The full system will give PM mass flow.

It is crucial to note that only the abovementioned configurations may be used for the ETS program, and no other technologies—such as the Broken Bag Detector—may be used as a substitute.

Suitability of a CEMS device depends on stack characteristics, process parameters, and air pollution control devices (APCDs) currently installed. The selection matrices in table 1 and table 2 should be used when selecting the CEMS device and flow meter (if applicable).

3.0 Selection of CEMS Vendor

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. In particular, since the ETS guidelines specify that the CEMS device is certified only after passing an accuracy test, it is recommended that industries withhold payment until then. A sample contract between the industry and the vendor can be found in the companion document *Industry Guidelines for Selection, Installation, and Operation of CEMS*.

Table 1: Matrix of Stack Characteristics for Selection of PM 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.

Table 2: Matrix of Stack Characteristics for Selection of Flow Meter

Type	Impact Differential Pressure		Thermal Anemometer	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^oC (model specific)	450° C - 850 °C (model specific)	Up to 1000^oC
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.

3.0 CEMS Device Requirements

3.1 Hardware Requirements

1. The PM CEMS device and flow-meter should have international certification (such as US EPA, MCERTS, TUV, ISO 9001: 2008, etc.) covering basic operational characteristics.
2. Beyond international certification, industries must also ensure the device contains specifications of key operating parameters such as: physical accuracy, response time, minimum detection limit (for flow meters), security measures to prevent unauthorised maladjustment, and inclusion of diagnostic flags. The table below gives guidance for the key operating parameters

Key Operating Parameters for PM CEMS

Name of Parameter	Specifications	
	PM CEMS	Flow Meter
Measurement range	User defined	User Defined
Instrumental 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
Accuracy*	< 5%	<2% of measuring range
Drift	< 1% per month	Overall zero & span drift should be < 1% per month
Flue gas	User specific	Minimum 1 dew point; User Specific
Power supply	220 +/- 10 V at 50 Hz	

*Accuracy: It is the accuracy in measurement of the raw value of what flow meter measures. For Differential Pressure based flow meter, it is the Pressure, so accuracy here represents the accuracy in the measurement of pressure difference.

3. It is required that the CEMS device sends ***uncalibrated*** data to the DAS. Calibration factors will be applied by the CEMS software. If this is not possible, the CEMS software should apply a calibration factor of '1'.
4. The CEMS device should be tamper-proof

3.2 Software Requirements

The vendor must provide accompanying software which is ETS compatible. This means it must be able to send the data in the prescribed format and should pass the System Integration Test for the CEMS Software. It is the responsibility of the vendor to provide compatible software and pass the System Integration Test, and it is the industries' responsibility to ensure the vendor has done so.

3.3 Performance Requirements

Industries must ensure that the PM CEMS device is in accordance with the stipulated performance standard. This involves passing a Performance Test after the device is calibrated (called as the Post-Calibration Performance Test) to check that calibrated CEMS readings are reliable. **The vendor should take the responsibility that the CEMS device passes the Post-Calibration Performance Test**. It is recommended that industries withhold payment to the vendor until the device passes this test. For technical details of the post-calibration performance test, see *Industry Guidelines for Selection, Installation, and Operation of CEMS*