

Background

For real-time pollution monitoring, the Central Pollution Control Board (CPCB) has mandated installation of Continuous Emission Monitoring System (CEMS) for stack emissions and Continuous Effluent Quality Monitoring System (CEQMS) for effluent-quality monitoring in 17 categories of highly polluting industries and common pollution-control facilities in India. The initiative took off with directions issued by CPCB in February 2014. Installation of CEQMS was also mandated in February 2014 for grossly polluting industries that dispose of effluents in the Ganga River and its tributaries. The purpose of implementing the continuous monitoring programme is to improve environmental compliance and enforcement by ensuring credible and accurate pollution monitoring and reporting in Indian industries.

Nearly 4,000 industries needed to instal CEMS and CEQMS. A majority have already installed and connected with the CPCB and their respective State Pollution Control Boards (SPCBs) or Pollution Control Committees (PCCs) for online data transfer and reporting.

Mere installation of equipment and online data transfer to the regulatory agency doesn't serve the purpose; the majority of installations have been noted to be problematic. Owing to the complex technology and cost involved, complications were high largely in correct CEMS selection, installation, operation and maintenance (O&M), and data transfer. The absence of the CEMS guidelines for over three years from the start of the CEMS initiative made it susceptible to going wrong. Issues related to CEQMS are fewer as its technologies are less complex and costly than CEMS's and, simultaneously, brief *Guidelines for Online Continuous Monitoring Systems for Effluents*¹ were also made available by November 2014, i.e. within six months after the initiative took off. However, with an absence of adequate skills, installation and operation issues also appear with regard to CEQMS.

With the absence of adequate information and timely guidance, the industries and regulators failed to ensure proper implementation of the real-time monitoring initiative. The problematic or incorrect installations need to be corrected in order to ensure accurate pollution monitoring and reporting.

The CPCB published *Guidelines for Continuous Emission Monitoring Systems* in August 2017,² after a gap of over three years since the inception of the CEMS initiative. This gave an opportunity for course correction. Compliance enforcement is the responsibility of regulators and it is the need of the hour that the SPCBs and PCCs carry out an inspection of the CEMS installations in industries, assess and evaluate the need for corrective measures and strategically plan for corrective actions.

This inspection manual has been prepared with the objective of guiding regulators in the inspection of CEMS and CEQMS technology selection, installations, operation and maintenance, data acquisition, and reporting practices in order to strengthen the compliance enforcement system. Industry officials can also use this manual to carry out self-assessment of CEMS and CEQMS implementation in their facilities and initiating corrective measures accordingly.

1.1 NEED FOR AN INSPECTION MANUAL TO IMPLEMENT REAL-TIME MONITORING

Inspection is a process of careful and systematic examination. The objective of an inspection is to examine whether implementation of the continuous monitoring system³ in a particular facility is correct, and it follows the standards and other regulatory requirements.

This inspection manual aims to guide pollution-control officials and environment professionals from industries with regard to proper inspection of installation of continuous monitors, assessing gaps in implementation and possible corrective measures. Post-inspection, regulators can suggest adequate corrective measures to rectify identified issues. Through inspection, industry personnel can self-assess and take corrective measures for proper implementation of CEMS and CEQMS.

The approach of regulators should be proactive, rather than only reactive. They should be able to guide, train, create awareness and assist industries in rectifying problems and improve the pollution-control and monitoring regime. Industry personnel also need to be proactive with regard to proper implementation of continuous monitoring systems in the facility.

1.2 ABOUT CONTINUOUS MONITORING SYSTEMS

Continuous monitors are tools for monitoring the characteristics of gas (flue gas and ambient air) and effluent quality in real-time. CEMS is used to monitor flue gas characteristics such as concentration of particulate matters (PM), gaseous pollutants (sulphur dioxides, nitrogen oxides, oxygen, carbon monoxide, hydrogen chloride, hydrogen fluoride, ammonia, mercury etc.), temperature, moisture, pressure and gas flow etc.

A complete CEMS comprises a particulate matter probe, flue gas sampling system, sample conditioning system, and a set of analysers or sensors integrated with hardware and software. The PM sensor directly

Key components of CEMS and CEQMS

Particulate matter CEMS	<ul style="list-style-type: none"> • Light source and receiver • Probe/sensor • Optics • Sampler and sample line • Air blower
Gaseous CEMS	<ul style="list-style-type: none"> • Sampler • Heated/non-heated sampling line • Sample conditioning system • Analyser • Flue gas temperature monitors • Flow meter • Pressure monitor
CEQMS	<ul style="list-style-type: none"> • Sampler • Sampling line • Holding jar • Probe/sensor • Video camera • Flow meter
Data acquisition system (DAS)	<ul style="list-style-type: none"> • Analog to digital converter (if the analyser produces analog data) or LAN/GPRS communication • Internet connection • REST-based API (Representational State Transfer-based Application Programming Interfaces) • Server software, server installed at facility, SPCB, PCC and CPCB

monitors dust in flue gas, the sampling system collects the gas sample, the conditioning system prepares the sample for optimal analysis in the analyser, and hardware and software carry tools for data acquisition, storage and transfer. In the case of ambient air quality, continuous ambient air quality monitoring system (CAAQMS) is used.

Similarly, CEQMS is used to monitor the quality of water or wastewater parameters such as pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solid (TDS), total suspended solids (TSS), dissolved oxygen (DO) and flow. As in CEMS, it comprises a sampling system, and analyser or sensors integrated with hardware and software systems to collect and handle the data.

Apart from the above mentioned components of CEMS and CEQMS, inspection will be carried for infrastructure facilities where and how these units are placed and managed.

Implementation of real time monitoring framework in India includes the following aspects:

- Selection of suitable quality assured monitoring system
- Correct installation
- Calibration during installation
- Real-time data acquisition and transfer system
- Regular operation and maintenance for quality control during operation

(See Figure 1: *Schematic representation of a typical continuous monitoring system framework in India*)

1.3 LEGAL PROVISIONS

The CPCB has mandated installation of continuous monitors in industries and common pollution treatment facilities. So far, the initiative has targeted installation of monitors and acquisition of real-time data to state and central regulators, not real-time data for compliance checks. There is no legal provision in the existing environmental legislation to use real-time monitored data for compliance enforcement.