

# **Legal Framework and Prescribed Standard Methods for Real Time Monitoring**

# National Policy on Online Monitoring

In “National Environment Policy” it is envisaged that to strengthen the testing infrastructure and network for monitoring ambient environmental quality and progressively ensure real-time, and online availability of the monitoring data

# Regulatory Regime

- Consent orders of SPCBs/PCCs specify standards to be complied by industries
- Industries submit analysis reports to SPCBs/PCCs and invariably copies are marked to CPCB
- Reports submitted by industries largely comply with the consent standard limits in contrast to the samples collected by SPCBs/PCCs/CPCB that by and large remains non complying.
- Actions (based on manual monitoring methodology) against industries are not leading to improvement in treatment processes by the units besides the persistent defaulters remains non committal.

## Regulatory Regime (contd.)

- Monitoring mechanism is weak due to lack of logistics, manpower and resources among the SPCBs/PCCs/CPCB obviously due to vastness of the jurisdiction area for regional offices and Zonal offices.
- Remedy is to put in place alternate monitoring mechanism on self monitoring methodology by industries and provide online data to regulatory regime.

# Emission Limits for Selected Industries

S.N	Industries / Facilities	Units of Operation	Parameters prescribed	Notified Standard Emission Limits	Remarks / Possible Types of CEMS
01	Aluminum	Raw Material Handling	PM	150 mg/NM <sup>3</sup>	In situ PM CEMS NDIR for CO FTIR for CO and F DOAS for all
		Calcinations	PM	250 mg/NM <sup>3</sup>	
			CO	1% (Max)	
		Green Anode Shop	PM	150 mg/NM <sup>3</sup>	
		Anode Bake Oven	PM Total Fluoride	50 mg/NM <sup>3</sup> , 0.3 Kg/MT of Al	
Pot room	PM, Total Fluoride	150 mg/NM <sup>3</sup> Total F- 2.8 Kg/MT (Soderberg Tech.) 0.8 kg/t (Pre-baked Technology)			
02	Cement without Co-processing	Rotary Kiln	PM NO <sub>x</sub> SO <sub>2</sub>	30 / 50 / 100 mg/NM <sup>3</sup> 600 / 800 mg/NM <sup>3</sup> 100 mg/NM <sup>3</sup>	Cross Duct PM CEMS UV Photometry and Chemiluminescence for Extractive dilution system NDIR for CO IR GFC, FTIR, DOAS for multi-gas analysis
		Vertical Shaft	PM NO <sub>x</sub> SO <sub>2</sub>	50 / 75 / 100 / 150 mg/NM <sup>3</sup> 500 mg/NM <sup>3</sup> 200 mg/NM <sup>3</sup>	
	Cement Co-processing	Rotary Kiln	PM NO <sub>x</sub> SO <sub>2</sub>	30 mg/NM <sup>3</sup> 600 / 800 / 1000 mg/NM <sup>3</sup> 100/700/1000 mg/NM <sup>3</sup>	
03	Distillery	Boiler	PM	150 mg/NM <sup>3</sup>	In situ / Cross Duct PM CEMS
04	Chlor-Alkali	( Hypo tower) HCl Plant	Cl <sub>2</sub> HCl	15 mg/NM <sup>3</sup> HCl vapour and Mists – 35 mg/NM <sup>3</sup>	UV Photometry, FTIR, DOAS Mist Not Possible
05	Fertilizers	Phosphate	PM, Fluoride	PM – 150 mg/NM <sup>3</sup> Total Fluoride – 25 mg/NM <sup>3</sup>	In situ / Cross Duct PM CEMS FTIR / DOAS for F
		Urea (Old)before 01.01.1982  Urea (New)after 01.01.1982	PM Fluoride PM Fluoride	150 mg/NM <sup>3</sup> 2 Kg/MT of product 50 mg/NM <sup>3</sup> 0.5 Kg/MT of product	

**Emission Limits for Selected Industries ..... Contd.**

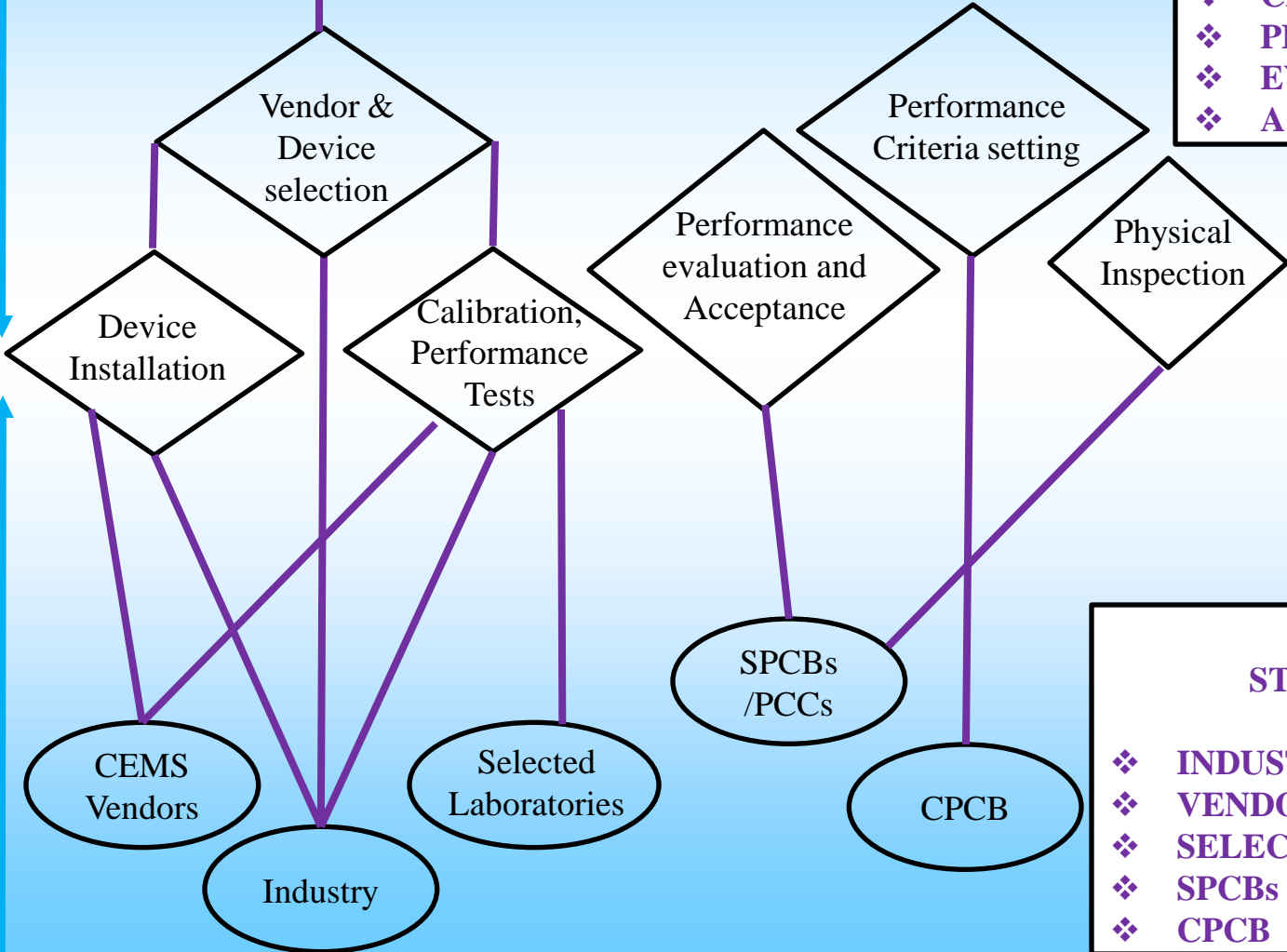
S.N	Industries / Facilities	Units of Operation	Parameters prescribed	Notified Standard Emission Limits		Remarks
06	Iron & Steel	Coke Oven Plant				Cross Duct PM CEMS UV Photometry and Chemiluminescence for SO2 and NOX respectively for Extractive dilution system NDIR for CO IR, IR GFC, FTIR, DOAS for multi- gas analysis
		New Batteries	PM	50 mg/NM3		
		Rebuild Batteries	SO2	800 mg/NM3		
		Existing Batteries	NOX	500 mg/NM3		
		Sintering Plant	PM	150 mg/NM3		
		Blast Furnace		Existing Units	New Units	
			PM	50 mg/NM3	30 mg/NM3	
			SO2	250 mg/NM3	200 mg/NM3	
			NOX	150 mg/NM3	150 mg/NM3	
			CO	1% (Max)	1% (Max)	
07	Oil refinery	Furnace, Boiler and captive power plant Gas based	PM	Before 2008	After 2008	Cross Duct / Insitu PM CEMS UV Photometry and Chemiluminescence for SO2 and NOX Extractive dilution system NDIR for CO IR GFC, FTIR, DOAS for multi-gas analysis
			SO2	10 mg/NM3	5 mg/NM3	
			NOX	50 mg/NM3	50 mg/NM3	
			CO	350 mg/NM3	250 mg/NM3	
		Furnace, Boiler and captive power plant Liquid Fuel based		Before 2008	After 2008	
			PM	100 mg/NM3	50 mg/NM3	
			SO2	1700 mg/NM3	850 mg/NM3	
			NOX	450 mg/NM3	350 mg/NM3	
			CO	200 mg/NM3	150 mg/NM3	
		Sulphur Recovery Unit (SRU)		Existing SRU	New SRU	
			H2S	15 mg/NM3	10 mg/NM3	
			NOX	350 mg/NM3	250 mg/NM3	
			CO	150 mg/NM3	150 mg/NM3	
08	Petrochemical	Furnace, Boiler Heater Vaporizer Liquid Fuel based		Existing Plant	New / Expansion	Cross Duct / In situ PM CEMS UV Photometry and Chemiluminescence for SO2 and NOX Extractive dilution system NDIR for CO IR GFC, FTIR, DOAS for multi-gas analysis
			PM,	100 mg/NM3	50 mg/NM3	
			SO2	450 mg/NM3	350 mg/NM3	
			NOX	1700 mg/NM3	850 mg/NM3	
			CO	200 mg/NM3	150 mg/NM3	
		Furnace, Boiler Heater Vaporizer Gas based		Existing Plant	New / Expansion	
			PM,	10 mg/NM3	5 mg/NM3	
			SO2	50 mg/NM3	50 mg/NM3	
			NOX	350 mg/NM3	250 mg/NM3	
			CO	150 mg/NM3	100 mg/NM3	

S.N	Industries / Facilities	Units of Operation	Parameters prescribed	Notified Standard Emission Limits		Remarks
09	Power Plant	TPP Installed before 31st December 2003	PM NOX SO2 Hg	Less than 500 MW 100 mg/NM3 600 mg/NM3 600 mg/NM3 0.03 mg/NM3	More than 500 MW 100 mg/NM3 600 mg/NM3 200 mg/NM3 0.03 mg/NM3	Cross Duct PM CEMS UV Photometry and Chemiluminescence for SO2 and NOX Extractive dilution system IR GFC, FTIR, DOAS for multi-gas analysis For Hg Gold amalgamation or Thermal desorption followed by AAS / AFS
		TPP Installed before 1st January 2004 upto 31st December 2016	PM NOX SO2 Hg	Less than 500 MW 50 mg/NM3 300 mg/NM3 600 mg/NM3 0.03 mg/NM3	More than 500 MW 100 mg/NM3 600 mg/NM3 200 mg/NM3 0.03 mg/NM3	
		TPP Installed before 1st January 2017 onward	PM NOX SO2 Hg	30 mg/NM3 100 mg/NM3 100 mg/NM3 0.03 mg/NM3		
10	Zinc	Smelter SRU	PM SO2	Old units 100 mg/NM3 1370 (Upto 300 T) 1250 (above 300 T)	New Units 75 mg/NM3 1250 (Upto 300 T) 950 (above 300 T)	Cross Duct / Insitu PM CEMS Cross Duct PM CEMS UV Photometry Extractive dilution system ,IR GFC for in situ system
11	Copper	Smelter SRU	PM SO2	Old units 100 mg/NM3 1370 (Upto 300 T) 1250 (above 300 T)	New Units 75 mg/NM3 1250 (Upto 300 T) 950 (above 300 T)	
12	Biomedical Incinerator	Incinerator Stack	PM NOX HCl CO & CO2 Temp. P.C.C Temp. S.C.C.	150 mg/NM3 450 mg/NM3 50 mg/NM3 Combustion Efficiency 99% 850 ± 50 °C 1050 ± 50 °C		Insitu PM CEMS, UV Photometry and Chemiluminescence for SO2 and NOX Extractive dilution system IR GFC, FTIR, DOAS for multi-gas analysis Hot Extractive system is the best
13	Common Hazardous Waste Incinerator	Incinerator Stack	PM HCl, SO2 CO NOX HF, O2 TOC	50 mg/NM3 50 mg/NM3 200 mg/NM3 100 (30 min); 50 (24 hourly) mg/NM3 400 mg/NM3 4 mg/NM3 ≤ 11% 20 mg/NM3		Cross Duct / Insitu PM CEMS UV Photometry and Chemiluminescence for SO2 and NOX Extractive dilution system IR GFC, FTIR, DOAS for multi-gas analysis Hot Extractive system is the best

# FIRST STEP OF IMPLEMENTATION OF CEMS

## CEMS Device

Selection Guidelines  
Performance criteria, COP,  
Operating Requirements



- ### ACTIVITIES
- ❖ SELECTION
  - ❖ INSTALLATION
  - ❖ CALIBRATION
  - ❖ PERFORMANCE TESTS
  - ❖ EVALUATION
  - ❖ ACCEPTANCE

- ### STAKEHOLDERS
- ❖ INDUSTRY
  - ❖ VENDOR
  - ❖ SELECTED LABORATORIES
  - ❖ SPCBs / PCCs
  - ❖ CPCB



## SECOND STEP OF IMPLEMENTATION OF CEMS

### ACCEPTED CEMS DEVICE

Registration of DAHS with Regulator

Ensure uninterrupted, raw, unaltered data transfer to SPCB/CPCB servers

Operation and Maintenance of CEMS

Regular Zero & Span Check

Intermittent Calibration Verification Check

Regulator's server

CEMS Vendors

Industry

SPCBs / PCCs / CPCB

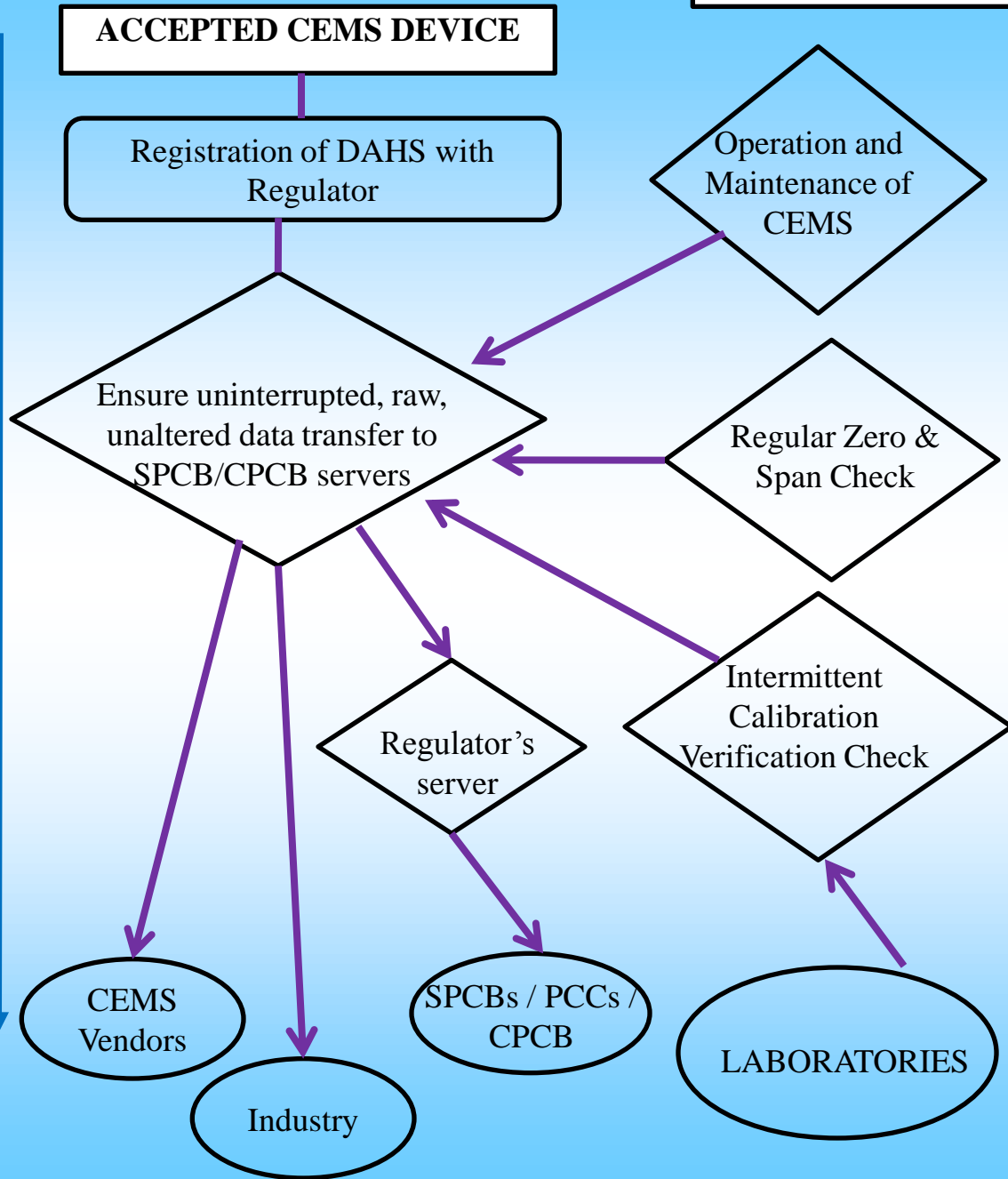
LABORATORIES

### ACTIVITIES

- ❖ DAHS CONNECTIVITY
- ❖ O & M OF CEMS
- ❖ ZERO – SPAN CHECK
- ❖ CAL VERIFICATION
- ❖ ALARM AND ACTIONS

### STAKEHOLDERS

- ❖ INDUSTRY
- ❖ VENDOR
- ❖ SELECTED LABORATORIES
- ❖ SPCBs / PCCs
- ❖ CPCB



# THIRD STEP OF IMPLEMENTATION OF CEMS

ACQUIRED CEMS DATA AT  
REGULATOR'S SERVER

Data screening & Validation

Scrutiny of Missing Data,  
Industrial Responses to  
Alarms, Out of Control  
Data

Intimation to  
Industry

Industrial  
Response

Regulator's  
Decision

SPCBs / PCCs /  
CPCB

Zero Drift  
Verification

Span Drift  
Verification

Calibration Drift  
Verification

LABORATORIES

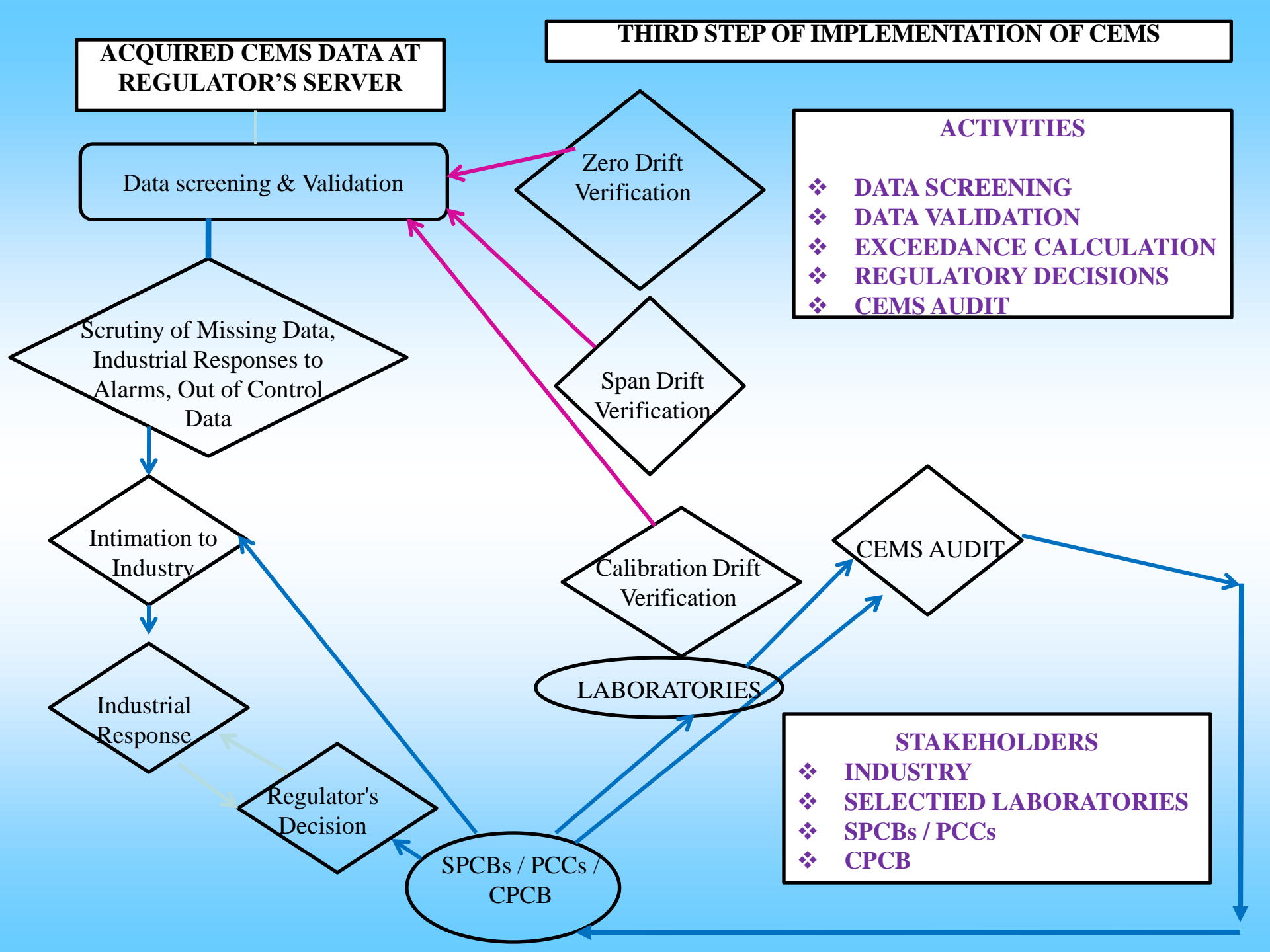
CEMS AUDIT

## ACTIVITIES

- ❖ DATA SCREENING
- ❖ DATA VALIDATION
- ❖ EXCEEDANCE CALCULATION
- ❖ REGULATORY DECISIONS
- ❖ CEMS AUDIT

## STAKEHOLDERS

- ❖ INDUSTRY
- ❖ SELECTED LABORATORIES
- ❖ SPCBs / PCCs
- ❖ CPCB



# CEMS Data: Broad System View

## CEMS DEVICE AT INDUSTRY SITE

- Technology selection guidelines
- Installation, calibration and maintenance procedures and performance standards

## DATA TRANSFER AND COMMUNICATION

- Open, transparent, vendor neutral system connecting CEMS device and PCBs server
- Reliability, quality, availability

## SPCB SERVER

- Storage, validation, analysis of CEMS Data
- Facilitating regulatory functions and other administrative requirements

# Check list for Inspection and Certification of Installation of CEMS

## *A. General Information*

SN	Particulars	Information
1	Name of the Company	
2	Address	
3	Type (Category)	
4	Contact Person	
5	E. Mail	
6	Phone Numbers	

## *B. Information on Source Emission*

SN	Particulars	Information
1	Application Description	
2	Size or Production Capacity	
3	Average Running Load	
4	Number of Emission points of process stacks for which Emission Limits are Prescribed	
5	Number of Emission points of process stacks installed CEMS	
6	Air Pollution Control Devices (APCDs) of individual emission points	
7	Parameters covered under CEMS for individual stack	

## ***B. Information on Source Emission - Contd.***

<b>8</b>	<b>Type of CEMS installed (In-situ or Extractive)</b>	
<b>9</b>	<b>Technology adopted for individual parameters</b>	
<b>10</b>	<b>Parameter wise Make and Model of individual CEMS installed</b>	
<b>11</b>	<b>The Sample conditioning system if Extractive CEMS are Used</b>	
<b>12</b>	<b>Distance between probe and analyser in case of extractive CEMS</b>	
<b>13</b>	<b>Whether Flue gas Temperature, Moisture, Velocity and diluents (O<sub>2</sub> and or CO<sub>2</sub>) monitoring systems are installed; if Yes detail thereof;</b>	
<b>14</b>	<b>Location of DAHS</b>	
<b>15</b>	<b>Shelter or Analyser Location</b>	
<b>16</b>	<b>Availability of Calibration Gas cylinders attached to systems with concentrations and validity</b>	

**C. Flue Gas Stream Constituents at Sample Probe Location**

SN	Constituents	Expected Concentration		Ranges	
				Minimum	Maximum
1	SO2		ppm		
2	NOX		ppm		
3	CO		ppm		
4	H2S		ppm		
5	NH3		ppm		
6	HCl		ppm		
7	HF		ppm		
8	Hydrocarbon		ppm		
9	O2		%		
10	CO2		%		
11	Opacity / PM		% / mg/NM <sup>3</sup>		

**D. Flue Gas Conditions at Sample Probe Location**

Condition	Expected Range	Observed Range	
		Minimum	Maximum
Flue gas Temperature (°C)			
Flue gas static pressure (mm H <sub>2</sub> O)			
Flue gas velocity (m/Sec)			
Particulate (mg/NM <sup>3</sup> )			
Moisture (%)			
Water Droplets (Yes or No)			
Fuel Used			
Quantity of Fuel Burnt			

*Note: The values recorded should be in order of historical data*

### ***E. Ambient Environment at CEMS Enclosure Location***

<b>Check Points</b>	<b>Observation</b>	
<b>Elevation from sea level (m)</b>		
<b>Temperature (°C)</b>	<b>Minimum</b>	<b>Maximum</b>
<b>Relative Humidity (%)</b>	<b>Minimum</b>	<b>Maximum</b>
<b>Availability of UPS Yes / No</b>		

### ***F. Physical Arrangement at Probe Location***

<b>Check Points</b>	<b>Observation</b>
<b>Measurement location (Stack or Duct)</b>	
<b>Shape at Measurement Location (Circular or Rectangular)</b>	
<b>Height of the CEM from Ground Level (m)</b>	
<b>Distance of CEM downstream from last disturbance (m)</b>	
<b>Distance of CEM upstream from last disturbance (m)</b>	
<b>Inside Dimension at CEM location</b>	
<b>Wall thickness at CEM location</b>	
<b>Outside Dimension at CEM location</b>	
<b>Material of Construction of Stack or Duct</b>	
<b>Height of the manual Isokinetic sampling port (m)</b>	
<b>Distance between CEM and Isokinetic sampling port (m)</b>	

## ***G. Operational Aspects***

<b>Check Points</b>	<b>Observation</b>
<b>Calibration and Operation of Particulate CEMS</b>	
<b>Comment on CEMS Selection</b>	
<b>Comment on CEMS Installation Criteria</b>	
<b>Date of First Calibration</b>	
<b>Calibration at different Load Condition performed or not</b>	
<b>Present Dust Factor</b>	
<b>Actual Range of Measurement set in CEMS</b>	
<b>Number of calibration performed so far</b>	
<b>% Variations in selected Dust Factor with justification</b>	
<b>Reported unit of measurement</b>	
<b>Whether suitable corrections for Moisture, Temperature, Diluents (CO<sub>2</sub>, O<sub>2</sub>) are incorporated online in reports or not</b>	
<b>Records of servicing and maintenance is available or not</b>	
<b>Data Capture Rate</b>	
<b>Verify if there is any change in scaling in data logging and transfer</b>	
<b>At least last one month data</b>	
<b>Verify if there is any sealing at upper end at below the selected range</b>	
<b>Verify if there is sudden fall or rise of data without justification</b>	



## Calibration and Operation of Gaseous CEMS

<b>Comment on CEMS Selection</b>	
<b>Comment on CEMS Installation Criteria</b>	
<b>Comment on Sample Transfer line and conditioning in case of Extractive CEMS</b>	
<b>Date of First Calibration (Multipoint with establishment within selected range)</b>	
<b>Actual Range of Measurement set in CEMS</b>	
<b>Zero Drift (Daily, Weekly and Monthly)</b>	
<b>Span Drift (Daily, Weekly and Monthly)</b>	
<b>Span Gas Concentration (it should be at 80% of Range)</b>	
<b>Reported unit of measurement</b>	
<b>Whether suitable corrections for Moisture, Temperature, Diluents (CO<sub>2</sub>, O<sub>2</sub>) are incorporated online in reports or not</b>	
<b>Records of servicing and maintenance is available or not</b>	
<b>Data Capture Rate</b>	
<b>Verify if there is any change in scaling in data logging and transfer</b>	
<b>At least last one month data</b>	
<b>Verify if there is any sealing at upper end at below the selected range</b>	
<b>Verify if there is sudden fall or rise of data without justification</b>	











## How to deal with Excesses emission:

- (i) Any Exceedence of values over the prescribed standards or norms shall be considered as violation.**
- (ii) Instantaneous elevated data i.e. spikes with duration less than one minute shall be dealt separately and not considered for data averaging.**
- (iii) Continuous Exceedence of values upto 10% over the standards/norms for more than half an hour shall require preventive action from the industry.**
- (iv) Frequent Exceedence of the values i.e. more than 5% of the total data capture in a day of the prescribed standards/norms shall invite action from SPCBs/PCCs**
- (v) Any Exceedence of the monitored values as against the standards shall invite SMS & email to the industry from SPCBs/PCCs, requiring immediate feedback on the corrective action initiated/taken.**
- (vi) In case the emission/ discharge quality exceeds continuously the prescribed norms by 10% over the standards and for duration of one hour or more, the industry shall inform the SPCBs/PCCs of the action initiated to control the emission/discharges and the effectiveness of the measures taken. In case the industry fails to control the emissions/discharges within the norms it shall move towards closure of its operation following the laid down standard operating practices.**
- (vii) For any second failure of the industry to keep the emissions/discharges within 10% of the norms for period exceeding one hour the industry shall immediately move towards closure of its operation under intimation to SPCBs/PCCs.**
- (viii) The values recorded during calibration or during preventive maintenance shall not be considered for Exceedence and assessing the data capture rate.**
- (ix) Plant start-up or batch process starting emissions shall not be considered for averaging for the initial, 30 minutes period in case of batch processes or small furnaces/ boilers not operating continuously.**

## **A more rational and scientific approach to deal with Excesses emission:**

The German approach to using a PM CEMS is to build the statistical uncertainty (due to the factors of particle composition and size distribution) into the emission limit value. The correlation relation is not required to achieve a specific statistical accuracy (e.g., a confidence interval #10 percent at the emission limit value) to be approved. This approach is illustrated in the following example.

A municipal waste combustion facility has a base PM emission limit (EL) of 30 mg/dscm. Assume a specific source's PM CEMS correlation has a confidence interval (CI) at the emission limit of 4 mg/dscm (13 percent) and a tolerance interval (TI) at the emission limit of 11 mg/dscm (37 percent). Then, that specific source would have the following PM limitations

- No 30-minute average may exceed:  $2*EL + TI = 60 + 11 = 71$  mg/dscm.
- 97 percent of the annual 30-minute averages may not exceed:  $1.2(EL + CI) = 36 + 5 = 41$  mg/dscm.
- No daily average may exceed:  $EL + CI = 30 + 4 = 34$  mg/dscm.

Even with the uncertainty in the PM CEMS measurement, the correlation relationship can still be used as a basis for compliance. Traditionally, the EPA regulations have taken this uncertainty into account when a CEMS-based standard is adopted.

**Need Legal Support**



# Way Forward

1. Development of CEMS calibration protocol
2. Training to Laboratories for calibration of laboratories
3. Laboratory Accreditations for CEMS calibration
4. Data requirements / Data formatting for data robustness, outlier-values, missing data, spike-values etc.
5. Data capture & data utilization / data use
6. Revision in the standard (CEMS based Compliance)



**THANK YOU**

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