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

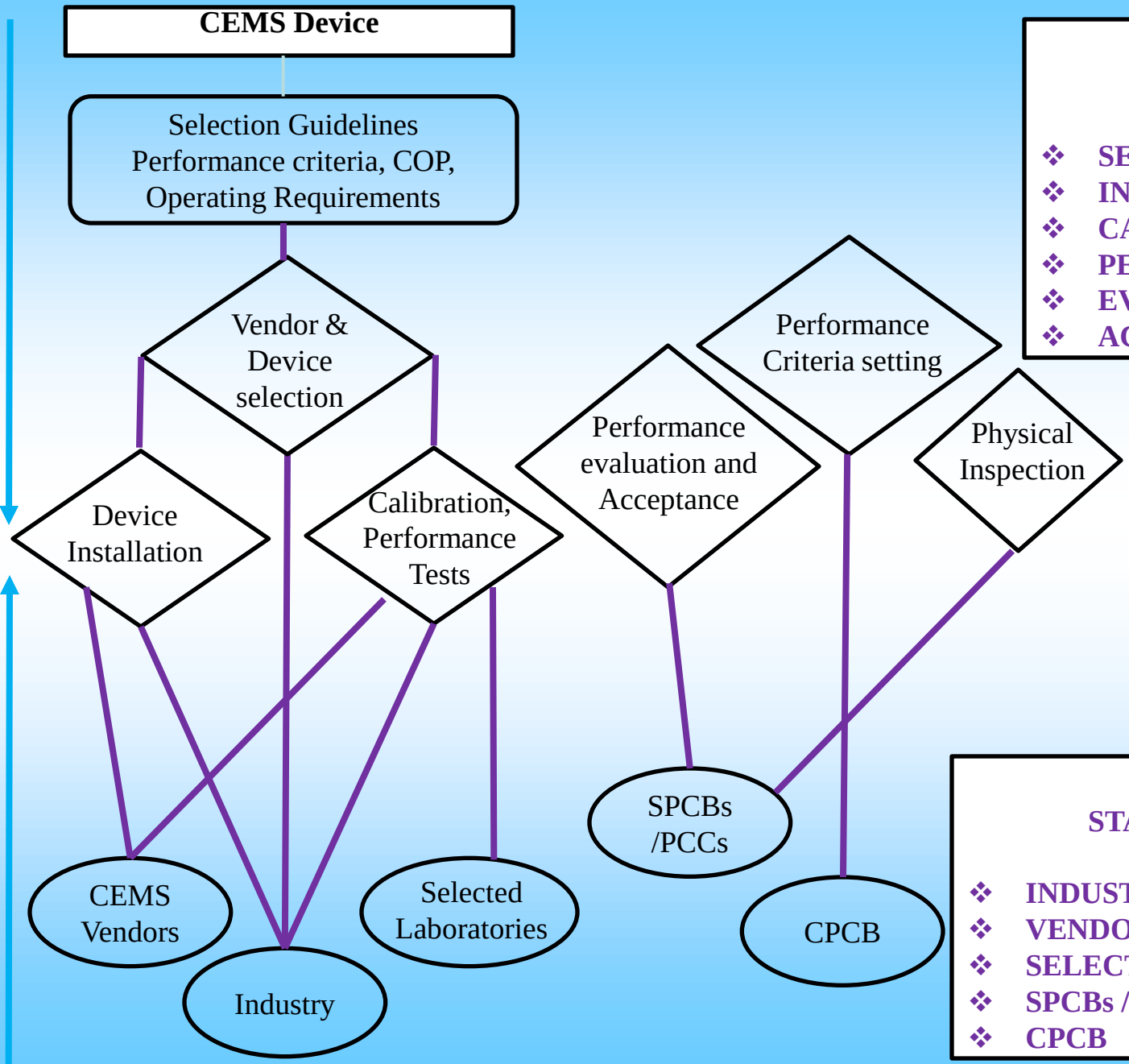
S.N	Industries / Facilities	Units of Operation	Parameters prescribed	Notified Standard Emission Limits	Remarks / Possible Types of CEMS
01	Aluminum	Raw Material Handling	PM	150 mg/NM^3	In situ PM CEMS NDIR for CO FTIR for CO and F DOAS for all
		Calcinations	PM CO	250 mg/NM^3 1% (Max)	
		Green Anode Shop	PM	150 mg/NM^3	
		Anode Bake Oven	PM Total Fluoride	50 mg/NM^3, 0.3 Kg/MT of Al	
		Pot room	PM, Total Fluoride	150 mg/NM^3 Total F^- 2.8 Kg/MT (Soderberg Tech.) 0.8 kg/t (Pre-baked Technology)	
02	Cement without Co-processing	Rotary Kiln	PM NO_X SO_2	30 / 50 / 100 mg/NM^3 600 / 800 mg/NM^3 100 mg/NM^3	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_X SO_2	50 / 75 / 100 / 150 mg/NM^3 500 mg/NM^3 200 mg/NM^3	
	Cement Co-processing	Rotary Kiln	PM NO_X SO_2	30 mg/NM^3 600 /800 / 1000 mg/NM^3 100/700/1000 mg/NM^3	
03	Distillery	Boiler	PM	150 mg/NM^3	In situ / Cross Duct PM CEMS
04	Chlor-Alkali	(Hypo tower) HCl Plant	Cl_2 HCl	15 mg/NM^3 HCl vapour and Mists – 35 mg/NM^3	UV Photometry, FTIR, DOAS Mist Not Possible
05	Fertilizers	Phosphate Urea (Old)before 01.01.1982 Urea (New)after 01.01.1982	PM, Fluoride PM Fluoride PM Fluoride	PM – 150 mg/NM^3 Total Fluoride – 25 mg/NM^3 150 mg/NM^3 2 Kg/MT of product 50 mg/NM^3 0.5 Kg/MT of product	In situ / Cross Duct PM CEMS FTIR / DOAS for F

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 New Batteries Rebuild Batteries Existing Batteries	 PM SO2 NOX	 50 mg/NM3 800 mg/NM3 500 mg/NM3		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
		Sintering Plant	PM	150 mg/NM3		
		Blast Furnace	 PM SO2 NOX CO	Existing Units 50 mg/NM3 250 mg/NM3 150 mg/NM3 1% (Max)	New Units 30 mg/NM3 200 mg/NM3 150 mg/NM3 1% (Max)	
07	Oil refinery	Furnace, Boiler and captive power plant Gas based	 PM SO2 NOX CO	Before 2008 10 mg/NM3 50 mg/NM3 350 mg/NM3 150 mg/NM3	After 2008 5 mg/NM3 50 mg/NM3 250 mg/NM3 100 mg/NM3	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
		Furnace, Boiler and captive power plant Liquid Fuel based	 PM SO2 NOX CO	Before 2008 100 mg/NM3 1700 mg/NM3 450 mg/NM3 200 mg/NM3	After 2008 50 mg/NM3 850 mg/NM3 350 mg/NM3 150 mg/NM3	
		Sulphur Recovery Unit (SRU)	 H2S NOX CO	Existing SRU 15 mg/NM3 350 mg/NM3 150 mg/NM3	New SRU 10 mg/NM3 250 mg/NM3 150 mg/NM3	
08	Petrochemical	Furnace, Boiler Heater Vaporizer Liquid Fuel based	 PM, SO2 NOX CO	Existing Plant 100 mg/NM3 450 mg/NM3 1700 mg/NM3 200 mg/NM3	New / Expansion 50 mg/NM3 350 mg/NM3 850 mg/NM3 150 mg/NM3	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
		Furnace, Boiler Heater Vaporizer Gas based	 PM, SO2 NOX CO	Existing Plant 10 mg/NM3 50 mg/NM3 350 mg/NM3 150 mg/NM3	New / Expansion 5 mg/NM3 50 mg/NM3 250 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		Less than 500 MW	More than 500 MW	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
			PM	100 mg/NM3	100 mg/NM3	
			NOX	600 mg/NM3	600 mg/NM3	
			SO2	600 mg/NM3	200 mg/NM3	
			Hg	0.03 mg/NM3	0.03 mg/NM3	
		TPP Installed before 1st January 2004 upto 31st December 2016		Less than 500 MW	More than 500 MW	
			PM	50 mg/NM3	100 mg/NM3	
			NOX	300 mg/NM3	600 mg/NM3	
			SO2	600 mg/NM3	200 mg/NM3	
			Hg	0.03 mg/NM3	0.03 mg/NM3	
		TPP Installed before 1st January 2017 onward	PM	30 mg/NM3		
			NOX	100 mg/NM3		
			SO2	100 mg/NM3		
			Hg	0.03 mg/NM3		
10	Zinc			Old units	New Units	Cross Duct / Insitu PM CEMS Cross Duct PM CEMS UV Photometry Extractive dilution system ,IR GFC for in situ system
		Smelter	PM	100 mg/NM3	75 mg/NM3	
		SRU	SO2	1370 (Upto 300 T)	1250 (Upto 300 T)	
				1250 (above 300 T)	950 (above 300 T)	
11	Copper			Old units	New Units	
		Smelter	PM	100 mg/NM3	75 mg/NM3	
		SRU	SO2	1370 (Upto 300 T)	1250 (Upto 300 T)	
				1250 (above 300 T)	950 (above 300 T)	
12	Biomedical Incinerator	Incinerator Stack	PM	150 mg/NM3		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
			NOX	450 mg/NM3		
			HCl	50 mg/NM3		
			CO & CO2	Combustion Efficiency 99%		
			Temp. P.C.C	850 ± 50 °C		
			Temp. S.C.C.	1050 ± 50 °C		
13	Common Hazardous Waste Incinerator	Incinerator Stack	PM	50 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
			HCl,	50 mg/NM3		
			SO2	200 mg/NM3		
			CO	100 (30 min); 50 (24 hourly) mg/NM3		
			NOX	400 mg/NM3		
			HF,	4 mg/NM3		
			O2	≤ 11%		
			TOC	20 mg/NM3		

FIRST STEP OF IMPLEMENTATION OF CEMS



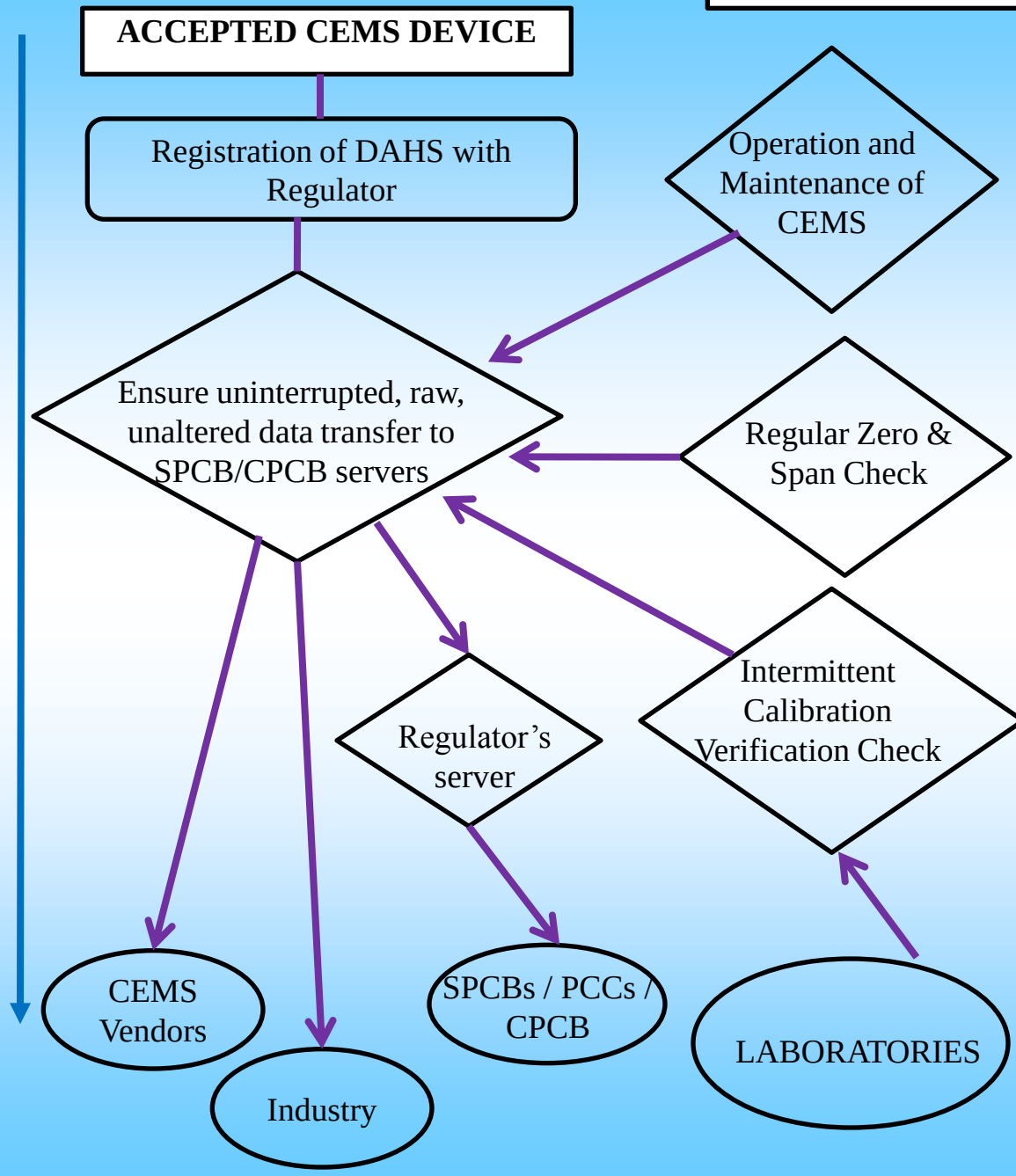
ACTIVITIES

- SELECTION
- INSTALLATION
- CALIBRATION
- PERFORMANCE TESTS
- EVALUATION
- ACCEPTANCE

STAKEHOLDERS

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

SECOND STEP OF IMPLEMENTATION OF CEMS



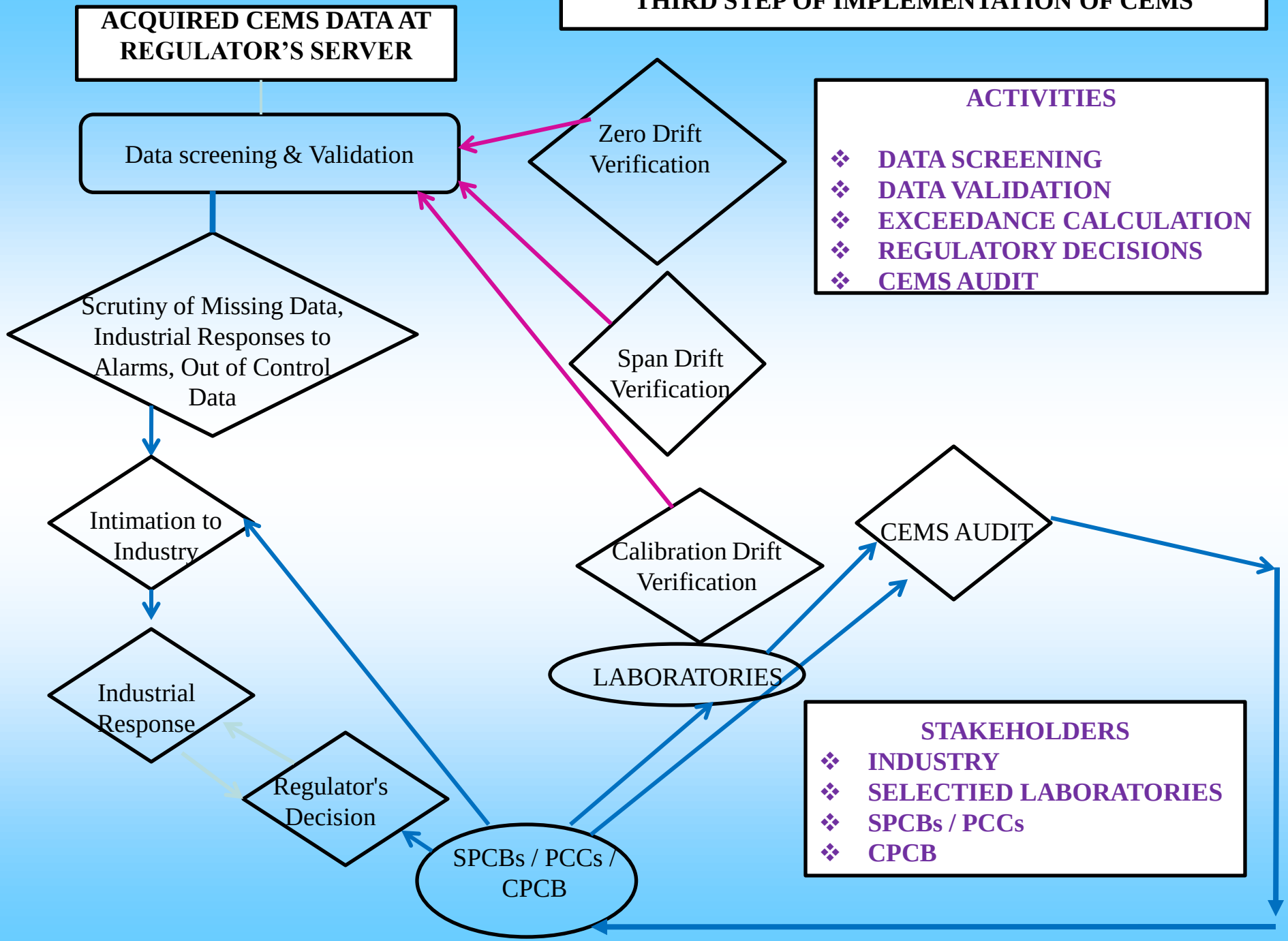
ACTIVITIES

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

STAKEHOLDERS

- INDUSTRY
- VENDOR
- SELECTIED LABORATORIES
- SPCBs / PCCs
- CPCB

THIRD STEP OF IMPLEMENTATION OF CEMS



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.

8	Type of CEMS installed (In-situ or Extractive)	
9	Technology adopted for individual parameters	
10	Parameter wise Make and Model of individual CEMS installed	

11	The Sample conditioning system if Extractive CEMS are Used	
12	Distance between probe and analyser in case of extractive CEMS	
13	Whether Flue gas Temperature, Moisture, Velocity and diluents (O_2 and or CO_2) monitoring systems are installed; if Yes detail thereof;	
14	Location of DAHS	
15	Shelter or Analyser Location	
16	Availability of Calibration Gas cylinders attached to systems with concentrations and validity	

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^3		

D. Flue Gas Conditions at Sample Probe Location

Condition	Expected Range	Observed Range	
Flue gas Temperature (ºC)		Minimum	Maximum
Flue gas static pressure (mm H_2O)			
Flue gas velocity (m/Sec)			
Particulate (mg/NM^3)			
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

Check Points	Observation	
Elevation from sea level (m)		
Temperature (ºC)	Minimum	Maximum
Relative Humidity (%)	Minimum	Maximum
Availability of UPS Yes / No		

F. Physical Arrangement at Probe Location

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

G. Operational Aspects

Check Points	Observation
Calibration and Operation of Particulate CEMS	
Comment on CEMS Selection	
Comment on CEMS Installation Criteria	
Date of First Calibration	
Calibration at different Load Condition performed or not	
Present Dust Factor	
Actual Range of Measurement set in CEMS	
Number of calibration performed so far	
% Variations in selected Dust Factor with justification	
Reported unit of measurement	
Whether suitable corrections for Moisture, Temperature, Diluents (CO_2, O_2) are incorporated online in reports or not	
Records of servicing and maintenance is available or not	
Data Capture Rate	
Verify if there is any change in scaling in data logging and transfer	
At least last one month data	
Verify if there is any sealing at upper end at below the selected range	
Verify if there is sudden fall or rise of data without justification	

Calibration and Operation of Gaseous CEMS	
Comment on CEMS Selection	
Comment on CEMS Installation Criteria	
Comment on Sample Transfer line and conditioning in case of Extractive CEMS	
Date of First Calibration (Multipoint with establishment within selected range)	
Actual Range of Measurement set in CEMS	
Zero Drift (Daily, Weekly and Monthly)	
Span Drift (Daily, Weekly and Monthly)	
Span Gas Concentration (it should be at 80% of Range)	
Reported unit of measurement	
Whether suitable corrections for Moisture, Temperature, Diluents (CO_2, O_2) are incorporated online in reports or not	
Records of servicing and maintenance is available or not	
Data Capture Rate	
Verify if there is any change in scaling in data logging and transfer	
At least last one month data	
Verify if there is any sealing at upper end at below the selected range	
Verify if there is sudden fall or rise of data without justification	

Continuous (Real time) Source emission Daily Monitoring Report Format

A) Source Information:

1.	Reporting Period	From:	To:
2.	Name of the Industry with ID (If any)		
3.	Plant Name		
4.	Stack ID		
5.	APCD		
6.	Operation Time (Hours)		

B) Information on CEMS

Parameter	Make	Instrument ID	Type	Span	Location

C) Information on CEMS Operation Summary

Parameter	Down time		Reasons	Corrective Actions
	From	To		

Parameter (P)	Units	Hourly Average Emission																						
		00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
24 hourly Data:		PM			SO_2			NO_X			CO_2			O_2			HCl			F			Others			
Min																										
Max																										
Average																										

Continuous (Real time) Source emission Monthly Monitoring Report Format

Pollutant	Inst ID	Stack ID	Data Capture Rate	Average monthly emission	Downtime	Reasons	Excess Emission events	Magnitude of Excess Emission	Zero – Span Calibration Drift	Maintenance / Repair of CEMS
			(%)	Units as applicable	% of source operation		(hrs.)	% from Standard limit	%	

Continuous (Real time) Source emission Quarterly Monitoring Report Format

Parameter	Instrument ID	Location	Data Capture Rate	Downtime	Zero – Span Calibration Drift	Out of Control Periods in terms of Drift	Corrective Actions	Leak Check Results	Linearity Check	Accuracy Test Report
			(%)	% of source operation	%					

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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