A case study on Real Time Pollution Monitoring System (RTPMS)

ANDHRA PRADESH POLLUTION CONTROL BOARD

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1. Overview

1.1 Situated in south-eastern part of India, Andhra Pradesh is surrounded by the States of Tamil Nadu, Karnataka, Telangana, Chhattisgarh and Odisha. It has a coast line of 970 km, stretching to the Bay of Bengal and has three major geographic regions: Coastal plains, Eastern Ghats, and Plateaus. The state has a population of 49.6 million as per 2011 Census, of which 30% are urban dwellers.

1.2 Andhra Pradesh Pollution Control Board (APPCB), as the regulatory authority, is entrusted to implement Environmental Laws and Rules within the State. APPCB envisions to achieve healthy environment for improved quality of life in Andhra Pradesh. The department is vigorous in development of research and environment management system. Real Time Pollution Monitoring System (RTPMS) is one such innovation by the APPCB to curb pollution caused by release of emissions / effluents by the industries into the environment.

1.3 RTPMS is developed by APPCB to ensure compliance to permissible emission / effluent levels, by the industrial units. RTPMS enables APPCB to efficiently keep track of the emissions / effluents from the industries remotely. Since implementation of RTPMS, the compliance w.r.t the permissible emission / effluent levels by the industries have greatly improved to about 95%. RTPMS has resulted in real-time, transparent and accurate data monitoring, and benefitted all the stake-holders viz. APPCB, industries and citizens.

2. Context and Background of RTPMS

2.0.1 Before implementation of RTPMS, the Board (APPCB) officials used to visit the industries regularly and carry out sampling / monitoring of the emissions / effluents and ambient air quality parameters. Each verification required physical visits to remote locations of different parts of the state in to collect the samples. These samples were then sent to different laboratories for analysis. The results of analysis usually came after 10-15 days of the inspection. Therefore, decisions pertaining to pollution parameters of the industries were taken only after 10-15 days of sample collection. This traditional method was time and energy intensive, with lesser data credibility because of the delay and other external causes.

2.0.2 Further, the data received based on manual samples was less reliable as the pollution parameters were susceptible to manipulation by the industries, during evaluation of the polluting parameters. Further, lack of an IT enabled system required APPCB to store

and track pollution related data of particular industrial unit over a period of time, through data archiving. The situation called for a process re-engineering in monitoring the industrial units.

2.0.3 APPCB categorically designed RTPMS to improve the pollution monitoring system, especially at a time when the state envisaged taking up its path to economic development with environmental sustainability. . Access to accurate data in real-time was the most urgent requirement for APPCB to ensure quick decisions.

2.0.4 RTPMS was implemented with the vision to:

1. Eliminate manual intervention
2. Initiate self-monitoring regime
3. Efficiency in time and cost
4. Remove manipulation of data
5. Improve transparency

2.0.5 APPCB implemented RTPMS to receive real time live data from all the highly polluting industries. The agenda was to access the data any time from remote locations. Any excess in the emission / effluent from the allowed levels would alert both APPCB as well as the industrial units. While this will facilitate APPCB to take quick decision to curb pollution, it will help the industrial units to take immediate corrective action to ensure compliance, aiding sustainability of environment and the surrounding ecosystem.

2.0.6 RTPMS was primarily implemented in Visakhapatnam as a pilot project where a significant number of Red and Orange category industries are located. Post successful implementation of RTPMS in Vishakhapatnam, along with quick acceptance by the industrial units, RTPMS was implemented successfully in the entire state.

2.1. Success Story of Pilot City: Visakhapatnam

Visakhapatnam is in the North-Eastern coast of Andhra Pradesh and major part of the city lies within two major hill ranges i.e., Yarada and Adavivaram (Simhachalam). The area located between the hill ranges and seacoast acts as a bowl area. There is a possibility of inversion happening in the bowl area during winters due to its location. The habitation and

industries co-exist in the bowl area (habitation developed in the surroundings of all major industries). There are 45 red category industries and 21 orange category industries established in the bowl area during the period 1970 – 1980. Major industries are as follows:

- M/s. Visakhapatnam Port Trust Ltd.
- M/s. HPCL, Visakha Refinery
- M/s. The Andhra Petrochemicals Ltd.
- M/s. Coromandel International Ltd.
- M/s. Rain CII Ltd.
- M/s. ESSAR Steels Ltd.

2.2. Situation before implementation of RTPMS for monitoring the pollutant levels:

2.2.1 Air pollution was a major concern till 2010 and Ministry of Environment and Forests (MoE&F) declared Visakhapatnam bowl area as critically polluted area. The Central Pollution Control Board (CPCB) studied major industrial clusters in India and Visakhapatnam was placed at 40th position by CPCB, with a CEPI score of 70.82 among 88 industrial clusters studied in the year 2009 and identified it as Critically Polluted Area (CPA). *(CPCB has developed a Comprehensive Environmental Pollution Index (CEPI), which is scientifically defined as a rational number to characterize the environmental quality at a given location following the algorithm of source, pathway and receptor.)*

2.2.2 Minimum score for declaration as CPA is more than 70. MoE&F vide its order dated 13th January 2010 imposed moratorium on consideration of projects for environment clearance in Visakhapatnam district, based on the CEPI score, but revised it to the bowl area vide MoE&F notification dated 15th March 2010.

2.2.3 The Board implemented the RTPMS and prepared an action plan to improve the environmental status of Visakhapatnam in consultation with stakeholders. In addition to individual targets to the industries in bowl area, the action plan included the following:

- Installation of Real Time Pollution Monitoring System (RTPMS) for industrial emissions / effluents; and
- Installation of Continuous Ambient Air Quality Monitoring Stations (CAAQMS) to get the live data of air quality in the critical areas

2.2.4 After installation of RTPMS & CAAQMS, the industries were made responsible to maintain the emission / effluent levels consistently within the standards, 24x7, and also to improve measures to reduce fugitive emissions to maintain the ambient air quality.

2.3. Stringent standards stipulated in bowl area:

Based on the data obtained from RTPMS & CAAQMS, APPCB imposed the following **stringent standards** for industries in bowl area:

Name of the industry	Parameter	National standard	APPCB standard for other areas	APPCB (stringent) standards for Visakhapatnam
M/s. Essar Steels Ltd.	SPM	150 mg/Nm^3	115 mg/Nm^3	50 mg/Nm^3
M/s. Rain CII India Ltd.	SPM SO_2	150 mg/Nm^3 --	115 mg/Nm^3 --	70 mg/Nm^3 0.48 TPD
M/s. Andhra Petro Chemicals Limited	SPM	150 mg/Nm^3	115 mg/Nm^3	50 mg/Nm^3
M/s. HPCL, Refinery	SPM SO_2	150 mg/Nm^3 --	115 mg/Nm^3 --	50 mg/Nm^3 11.5 TPD
M/s. Coromandel Fertilizers	SPM Fluorine SO_2	150 mg/Nm^3 25 mg/Nm^3 --	115 mg/Nm^3 10 mg/Nm^3 2.0 Kg/T	50 mg/Nm^3 5 mg/Nm^3 0.65 Kg/T of H_2SO_4

2.4. Additional Environment Measures:

, The following additional environmental measures were taken by the industries in Visakhapatnam Bowl area, in order to improve the Ambient Air Quality :

1. M/s. Visakhapatnam Port Trust:

Line of activity: Handling of various cargoes

- Installed 3 CAAQM stations at (i) GCB i.e. at the interface of Port and City near town area, (ii) R&D Yard i.e. at the interface of Port and City near Gnanapuram, and (iii) GVMC stadium i.e. at the interface of Port and City to monitor PM_{10}, $PM_{2.5}$, SO_2 and NOx continuously.
- M/s. Visakhapatnam Port Trust (VPT) provided a 10 MLD (Million Liters Per day) sewage treatment plant for sewage generated in the city area with an investment of Rs. 3 Crores. The treated sewage is being used for dust suppression purpose in port area.
- Mechanical handling of iron ore is ensured.
- VPT covered the iron ore conveyor belt where it is passing through the residential area to minimize fugitive emissions.
- VPT provided Mechanized Dust Suppression System at 3 major stock yards and West Quay Berths during 2002 with an investment of Rs.14 Crores. VPT is using treated sewage for dust suppression.
- VPT provided geo-net barrier at General Cargo Berth (GCB) area for a length of 240 meters with an investment of Rs.40 Lakhs.
- VPT provided covering to conveyor belt to an extent of 100 meters from Junction Houses H7 & H8 with an investment of Rs.50 Lakhs to minimize dust emissions.
- VPT and National Highways Authority of India (NHAI) completed the flyover connecting NH-5 and the port with an investment of Rs. 116 Crores. By routing through this flyover, the movement of dusty cargo truck through residential /commercial areas has been eliminated
- Trade /PPP /BOT operators are covering the stacks with tarpaulins on coal stacks.
- Mobile Fog Canons have been deployed since December 2015 and they are operational during loading / unloading of dusty cargos.
- New Truck Tyre Cleaning System facility at ESSAR junction was constructed and all the vehicles (about 500 per day) going out of port to port connectivity road are passing through these truck tyre washing systems to ensure that cargo/spillage struck to tyres is washed. This has reduced the dust on port connectivity road thereby improving the air quality.
- The coal stacks from North of S-4, R-11 area, and S-6 conveyor area i.e., nearer to city have been shifted to inside areas. Work was completed by June 2016.

2. M/s. Essar Steels Limited:

Line of activity: Iron ore palletization

- The industry has established Continuous Ambient Air Quality Monitoring (CAAQM) station to monitor PM10, PM2.5, SO2 and NOx continuously.
- The industry provided online stack analyzers to all stacks for continuous monitoring of PM10.
- The industry installed Electrostatic Precipitators in 2007 in place of existing multi cyclones to the Indurating Furnaces–I & II with an investment of Rs. 15 Crores and reduced SPM emissions.
- The industry is receiving iron ore fines in slurry form since 2005 from Bailadila, Madhya Pradesh, through 250 km pipeline. After commissioning of pipeline for transporting the raw material in slurry from the mines to the plant, the industry minimized dust pollution by storing iron ore fines in the premises and in port area.
- The industry is using water recovered from the slurry within the plant and reduced freshwater consumption.
- The industry removed slurry ponds in 2005 from 10 acres of land, minimized dust pollution problems and developed green belt in the area.
- The industry installed sprinklers at main storage yards.
- The industry provided captive power plant of 25 MW to ensure continuous power supply to the plant and pollution control systems and minimized process disturbances.
- The industry provided bag filters at various junction points of the raw material / product handling sections with an investment of Rs. 0.62 Crores.
- With an investment of Rs. 1.55 Crores, the industry constructed wind breaking wall towards habitation side at coal yards in 2008 to minimize the impact of fugitive emissions.
- The industry provided concrete roads in all areas during 2004-2005 and minimized the flow of dust due to truck movement.
- 7 high capacity sprinklers were installed in the coal stock yard to suppress the dust.
- The industry developed green belt in all areas with an investment of Rs. 1.75 Crores.

3. M/s. Rain CII India Limited:

Line of activity: Calcination of Petroleum Coke

- The industry has established 2 Continuous Ambient Air Quality Monitoring (CAAQM) stations to monitor PM10, PM2.5 & SO2 continuously and Continuous Stack Emission Monitoring Stations for the 2 stacks to monitor PM & SO2.
- Industry installed water sprinklers and wind breaking walls to control fugitive emissions in 2002. Further, with an investment of Rs. 1 Crore, the breaking walls were extended along the coke storage area in the 2009.
- The industry is using low sulfur fuels for the plant requirements.

4. M/s. Andhra Petro Chemicals Ltd:

Line of activity: Petrochemical industry

- The industry has established Continuous Stack Emission Monitoring Stations for the 2 stacks (12 TPH & 15 TPH Boilers) to monitor PM, CO, NOx Sox; 1 Continuous Ambient Air Quality Monitoring (CAAQM) station to monitor Hydrocarbons, NOx, PM, SOx and an online Effluent Monitoring System to monitor pH, TSS, COD & BOD continuously.
- The industry installed and commissioned a new stripper in the month of February 2013 to reduce the COD.
- The industry is routing its off gases to the flare stack to avoid release of VOC emissions into the atmosphere.
- The industry installed UPS with an investment of Rs. 6 Crores and terminated the continuous operation of 4.5 MW D.G. sets in the year 2006.

5. M/s. Hindustan Petroleum Corporation Limited, Visakh Refinery:

Line of activity: Petroleum refinery

- The refinery has established Continuous Stack Emission Monitoring Stations for the 35 stacks to monitor PM, CO, NOx Sox; 3 Continuous Ambient Air Quality Monitoring (CAAQM) stations to monitor Benzene, CO, NH3, NOx, O3, PM2.5, PM10, SO2 and an online Effluent Monitoring System to monitor pH, TSS, COD & BOD continuously.
- The refinery constructed ETP-I in 1993 and ETP-II in 1996 to meet the Minas standards.

- The refinery installed three Sulphur recovery units with an investment of Rs. 160 Crores in 1999 to minimize SO2 emissions and recovered 2200 tons of elemental Sulphur per month.
- The refinery expanded crude through put from 4.5 MMTPA to 7.5 MMTPA during 2000-2002 without increasing pollution load from the existing levels. The Board stipulated that the SO2 emissions from all the sources shall not exceed 11.5 TPD.
- The industry connected hot well-off gases of CDUs-I & II to the burners to minimize odor nuisance during 2007-08.
- Industry completed Oil Ingress project in 2009 to avoid entry of excess oil into ETP with an investment of Rs. 7.2 Crores.
- Oil recovered since 2002 from High Oil Sludge and Low Oil Sludge is sent to bio-remediation pit and is reprocessed.
- The industry provided 65 tons/day of Sulphur from recovery unit (SRU-III) under clean fuel project with an investment of Rs. 80 Crores in 2009.
- The industry proposed to provide flue gas de-spherization to FCCUs as a part of clean fuel project to reduce SPM & SO2 emissions in the ambient air further with an investment of Rs. 120 Crores.
- The industry has commissioned ETP- IV.
- The industry is using low sulfur fuels (0.5 by weight %) for their requirements.

6. M/s. Coromandel Fertilizers Limited:

Line of activity: Manufacture of complex fertilizers

- The industry provided online stack analyzers to Sulphuric acid plants for continuous monitoring of SO2.
- The industry has established Continuous Stack Emission Monitoring Stations for the 8 stacks to monitor PM, HF, SOx & NH3; 3 Continuous Ambient Air Quality Monitoring (CAAQM) stations to monitor NH3, NOx, PM2.5, PM10, SO2 and an online Effluent Monitoring System to monitor pH continuously. The industry stopped ammonia production and urea plant in 1999.

- During 1997, the industry established molten Sulphur facility and minimized solid Sulphur consumption gradually.
- The industry revamped its Double Conversion & Double Absorption (DCDA) Sulfuric acid plant in 2002 with an investment of Rs. 8 Crores.
- The industry de-commissioned pressurized Ammonia storage tank and commissioned two atmospheric storage tanks of 5000 tons each. The industry is importing Ammonia through ships and through a pipeline to the premises.
- The industry constructed warehouses for storage of all raw materials.
- Usage of 6MW DG set is stopped by the industry and the required power is being generated from turbo generator, where the steam generated from the sulfuric acid plants is used. The project was implemented in 2005.
- In 2006, the industry stopped fuel consumption in the complex fertilizer plants by installing air pre-heater by utilizing exothermic heat generated during reactions, with an investment of Rs. 6.5 Crores.
- The industry adopted dry disposal system of Gypsum and provided lining to an extent of 5 acres of existing Gypsum pond with an investment of Rs. 24 Crores during April 2009.
- The industry provided alkali scrubber to the 300 TPD and 1400 TPD Sulphuric acid plants to minimize the emissions i.e., Sulphur Dioxide, Sulphur Trioxide and acid mist with an investment of Rs. 1.65 Crore.
- The industry provided Fluorine Recovery Unit to recover Fluorine from the Phosphoric Acid.
- The industry provided Screw unloader at Wharf area to unload raw material of Sulphur, Rock Phosphate, etc., in place of Bucket Conveyor with an investment of Rs. 19 Crores.
- The industry has promoted green belt development on gypsum pond through bioremediation technology, recommended by the TERI, New Delhi in an extent of 18 acres with 18,000 plants.

7. M/s. Hindustan Zinc Limited:

Line of activity: Manufacture of Zinc

- The plant is not in operation since 2012 and it was dismantled.

2.5. Situation after installation of RTPMS for monitoring the pollutant levels

After installation of RTPMS, APPCB was able to access the data and identified the reasons for increase in pollution levels, on the basis of which several directions were issued to the industries to improve their existing pollution control measures. Due to the intervention of the Board and implementation of RTPMS, the CEPI score came down from 70.82 to 52.31 by 2013 during the pilot project implementation in Visakhapatnam. The reduction in the CEPI score was due to the stringent emission standards stipulated by the Board for PM and monitoring the excess from the prescribed standards using RTPMS (e.g. 50 mg/Nm^3 against CPCB standard of 115.0 mg/Nm^3). APPCB also insisted that all the industries located within the bowl area upgrade their air pollution control systems and effluent treatment plants. The industries invested about Rs. 1845 Crores to upgrade their pollution control equipment which included mechanization of port berths, up-gradation of air pollution control systems with ESPs, installation of new effluent treatment plants etc. APPCB laid a strict vigilance on all the industries and issued directions as required from time to time which helped in attaining the CEPI score of 44.74 after implementation of the project throughout the state.

- **Lifting of moratorium in Visakhapatnam bowl area**

  Based on the action taken and effective implementation of stringent standards, the MoE&F lifted moratorium vide Office Memorandum dated 17th September 2013.

- **Ambient air quality status**

  APPCB is monitoring of air quality in Visakhapatnam city on regular basis. The annual average of SO2 in Visakhapatnam bowl area (µg/m3) has witnessed a drastic reduction after implementation of RTPMS.

3. Problem Statement

Industrial Monitoring before implementation of RTPMS

- Physical visits to industrial units for sample
- Physical sample collection was time taking process
- Involved risk as officials required to
- Preservation, transportation and analysis of samples
- Generation of analysis report, post study and analysis of samples, takes several
- Board takes necessary action for non-compliant cases / exceedances based on the

Problems before implementation of RTPMS:

- Strain on the regulatory manpower and infrastructure
- Reports submitted by industries were in contrast with the samples collected
- Imperfect monitoring and reporting practices
- Limited scope of action against the defaulters
- Lack of transparency
- No mechanism for self-monitoring by the industrial units
- No improvement in treatment / processes based on manual monitoring
- More time taking for lab analysis and reporting
- Rs. 1.25 Crores spent on comprehensive industrial inspections
- Difficult decision making

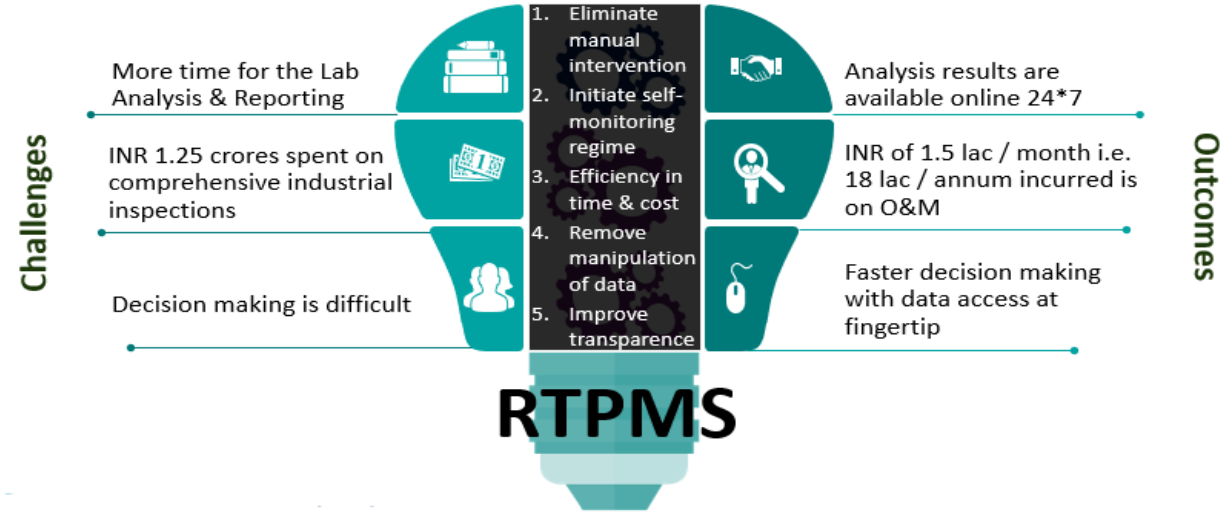
4. Solution through RTPMS

RTPMS was implemented to systemize the monitoring of pollution potential industries. Process re-engineering was the major feature of RTPMS through which several significant solutions were achieved. The need for physical visit to the industry was replaced by real-time online pollution monitoring system. RTPMS is developed to provide real time data which eliminated the difficulties caused due to delayed delivery of pollution analysis results. Now, the data is received in real time from the highly polluted industries and multiple reports are generated in a day.

All the stakeholders involved in the process receive information in real time to control the exceedance. Each analyzer provides real time accurate results to the industries. RTPMS enables APPCB to receive information from machines to server directly. In addition, RTPMS assisted APPCB to reduce the cost incurred on monitoring of pollution parameters by eliminating the physical verification process to remote locations, sample collection, manpower and analysis charges (chemicals, filter papers, equipment etc.). Approximately Rs. 50,000/- per comprehensive monitoring per industry was spent each year (around 250 industries in total). At present there is no capital expenditure from APPCB's side as RTPMS is implemented by the industry and connectivity is established by APPCB. The total expenditure incurred by APPCB after implementation of RTPMS in operations and maintenance (O&M) is Rs. 1.5 lac / month i.e. Rs. 18 lac / annum only.

4.1. Monitoring process simplified post implementation of RTPMS:

- **Remote Monitoring:** APPCB officials are now monitoring highly polluting industries remotely from head office
- **Emission / Effluent monitoring devices:** The industrial units are using emission / effluent monitoring devices to track the compliance levels
- **APPCB servers:** The devices are linked to APPCB's servers and update live data related to the emissions / effluents **is received**
- **Generate MIS in real time:** APPCB officials can generate report by logging on to RTPMS using authentic credentials
- **Action based on real time data:** APPCB officials can now take quick actions based



on the MIS reports reflecting real-time data fetched from RTPMS

4.2. Environment Monitoring Center

An Environment Monitoring Centre (EMC) is set up at the head office of Board in Vijayawada. The EMC functions as a monitoring centre where online data is carefully checked by senior APPCB officials. APPCB has appointed designated data processing officials to detect anomalies in data. In case of exceedance; EMC also issues SMS alerts to the industries and, field officials. All the industries being monitored through RTPMS are closely scrutinized by APPCB through EMC.

Key aspects of EMC:

- 846 analyzers are transmitting emission parameters
- 410 analyzers are transmitting the effluent parameters
- 533 analyzers are transmitting the ambient air quality
- Issuing SMS alerts to industries and field officers
- Auto generation of notices
- Dissemination of data on public domain

4.3. Solutions to the stakeholders

A) APPCB

- **Enhanced compliance:** With introduction of RTPMS, APPCB is able to regulate the industrial pollution from effluent / emission and ambient air quality even beyond the prescribed standards.
- **Savings in time, energy and cost :** RTPMS has replaced the long process of physical inspection with a real time online application. The time taken to analyze one sample is brought down from several days to few minutes. Prior to implementation of RTPMS, APPCB used to receive the analysis results post completion of the physical visit and it used to take several days to carry out the monitoring of every parameter in the emissions / effluent and ambient air quality. It used to take a total of 10-15 days before APPCB could take any action on the non-compliant industry based on the analysis report.
- **Quickened decision making:** RTPMS implementation has enabled APPCB to receive real time live data from all industries with pollution potential in a few minutes. Currently, the processed data is disseminated in real time and hence, APPCB can act on pollution compliance deviations within a short time. The system has enhanced the decision-making capacity of APPCB.

- **Enhanced transparency**: RTPMS provides accurate data to the regulator and the regulated industry. There is no scope of data manipulation or physical intervention in the system which enhances data transparency.
- **Online calibration**: Earlier calibration was done once a year by the manufacturer/supplier, however RTPMS enables APPCB to calibrate the equipment immediately online. This ensures regular access to accurate data and the accuracy of the data received from RTPMS is 90%.
- **Better regulation**: RTPMS enables APPCB to have quick and regular communication with all the industries. APPCB may alert an industry once its pollution level deviates from the agreed standards.
- **Live status of pollution parameters**: 846 analyzers are transmitting the emission parameters from polluting industries for 23 parameters. Officials need not rush to locations for the required data.

B) Industries

RTPMS not only enables APPCB to utilize the system for regulatory requirements, but also allows industries to access pollution data pertaining to their establishment. An industry may have the following benefits using RTPMS:

- **Enhanced compliance:** With introduction of RTPMS, every industry can know their status regarding the pollution standards and self-comply as required. Data archiving option enables the industry to track the compliance levels followed by them over a time period.
- **Time and cost saving:** RTPMS reduced the number of visits by inspectors. This brings down the time and expense spent on inspection related arrangements.
- **Access to Data:** Industry may log in with their ID to access pollution level data anytime.
- **Alerts Mechanism:** RTMPS enables industries to receive regular alerts as SMS on pollution exceedance. This enables industry to self-assess causes of exceedance and ensure pollution within permitted levels.

C) Citizens

The transparency in the whole process allows citizens to fact-check the decisions made by the board, permitted pollution levels, compliance standards of industries etc.

5. Way Forward

APPCB is keen in upgrading the existing RTPMS further with a constructive view of environmental sustainability. However, certified devices are not available in market,

Continuous Effluent Quality Monitoring System (CEQMS) is not feasible and approval is a big issue. Presently, India has allowed non-certified instruments in real time industrial monitoring till Indian certification system is established. Other major challenges include data transmission in remote areas due to poor connectivity and maintaining zero downtime.

For the way forward, following measures will be on priority:

- APPCB will scale up RTPMS from Red category industries and to be extended to Orange category industries
- APPCB will utilize RTPMS data including pollution history to enhance Research and Development (R&D) related to pollution control technologies
- Third party verification of calibration for the RTPMS equipment
- Installation of cameras in all industrial units for pollution monitoring
- Data obtained from RTPMS shall be used for regulatory purpose
- Any industry submitting wrong information / data will be made liable for action

6. Conclusion

For RTPMS there is no constraint with respect to hardware in terms of scalability. RTPMS software is developed on open source technology enabling it to be scalable for integration. However, RTPMS is often dependent on the local internet connectivity, failure of which limits the availability of accurate data. Also, there are no leased lines yet. APPCB has developed the software for all the existing models of the analyzer, in case a new equipment is launched in the market, a realignment with the client software is needed for connectivity with the system.

APPCB is dedicated to upgrade RTPMS further in terms of capabilities and to extend it to all the industrial units in the state. Further, APPCB also intends to use RTPMS to take actions against the defaulters to make all the industrial units responsible to achieve self-compliance.

7. Teaching Notes

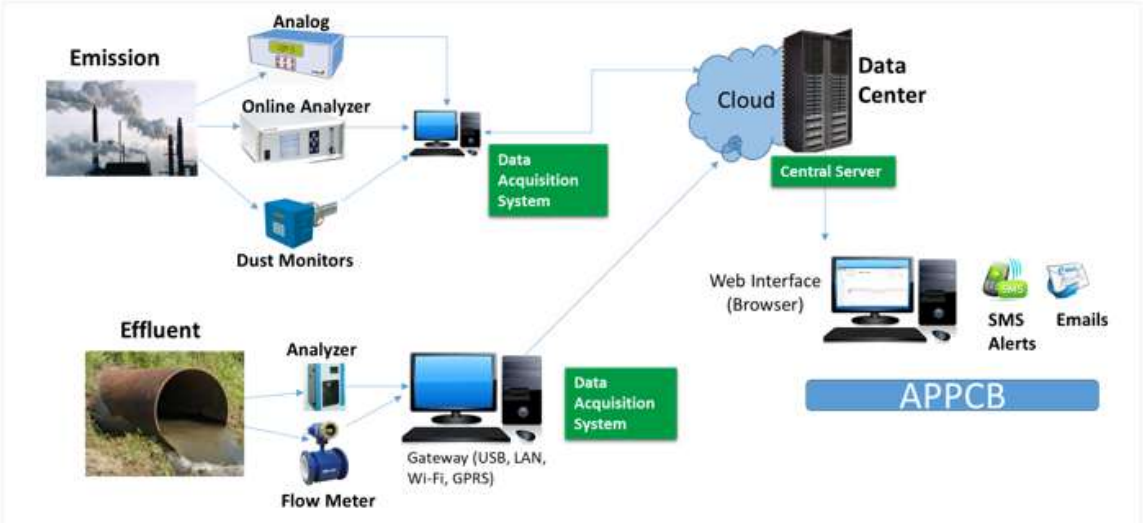
7.1. Learning Objectives:

- Understanding all challenges faced by APPCB to resolve complaints regarding air and water pollution.
- Use of cloud-based technology to develop an effective monitoring system to overcome the challenges.
- Bringing transparency in the process, allowing the industries, citizens and other stakeholders to track the real time status easily.

7.2. Suggested Questions & Analysis:

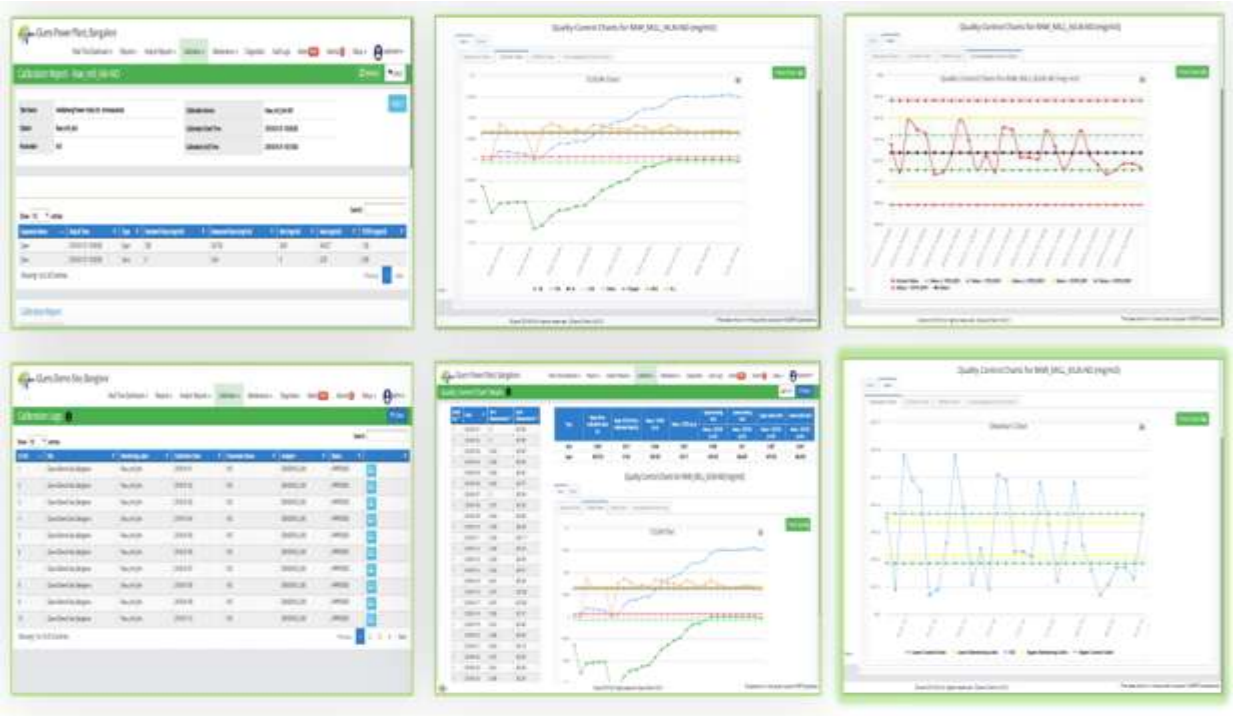
- What are the key points to be kept in mind while replicating the RTPMS model in other States?
- Analyze the real time pollution status of various industries in Andhra Pradesh, using the dashboard available on the website (http://aprtpms.ap.gov.in/publicview.html).

7.3. RTPMS Overview



7.4. Environment Monitoring Center

7.5. Data from RTPMS



7.6. Types of technologies available for air monitoring

a) In-situ

- Folded Beam
- Cross Duct

b) Extractive

- Hot / Wet (using heated analyzers)
- Dilution

- Drying System
  - Cooler
  - Dryer (Permeation)

7.7. Types of technologies available for wastewater monitoring

- UV Spectrophotometry
- UV-Visible Spectrophotometry
- Combustion Catalytic Oxidation
- UV Persulfate NDIR Detector / Persulfate Oxidation at 116- 130degC
- Nephelometry Method
- Calorimetric
- UV Absorbance or Multiple Wavelength
- Ion Selective Electrode method
- Wet chemical oxidation
- High temperature catalytic combustion oxidation
- IR light absorption

8. Abbreviations

A list of principal abbreviations and acronyms used in this document is provided here for a better understanding of the document

Abbreviation	Definition
APPCB	Andhra Pradesh Pollution Control Board
Board	Andhra Pradesh Pollution Control Board
BOD	Biochemical Oxygen Demand
BOT	Build-Operate-Transfer
CAAQMS	Continuous Ambient Air Quality Monitoring Station
CEPI	Comprehensive Environmental Pollution Index
COD	Chemical Oxygen Demand
CPA	Critically Polluted Area
CPCB	Central Pollution Control Board
EMC	Environment Monitoring Centre
ESP	Electrostatic Precipitator
ETP	Effluent Treatment Plant
FCCU	Fluid Catalytic Cracking Unit
GCB	General Cargo Berth
GVMC	Greater Vishakhapatnam Municipal Corporation
MIS	Management Information System
MLD	Million Litres per Day
MMTPA	Million Metric Ton per Annum
MoE&F	Ministry of Environment and Forests
NHAI	National Highways Authority of India
NOx	Oxides of Nitrogen
PPP	Public-Private Partnership
TPD	Ton per Day

RTPMS	Real Time Pollution Monitoring System
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
SO2	Sulphur Dioxide
SPM	Suspended Particulate Matter