Chapter-7

Air pollution due to thermal power plants

Introduction

Coal-based Thermal Power Plants (TPPs) are responsible for a disproportionately higher share of emissions than the industrial sector (60 *per cent* of PM, 45 *per cent* of SO_2, 30 *per cent* of NO_2 and 80 *per cent* of mercury (Hg))[1]. The CPCB has categorized TPP as highly polluting activities. Not modernizing old TPPs, poor quality of coal (high ash and sulphur content in the indigenous coal), legacy fly ash stocks, fugitive emissions due to coal and ash handling are the factors contributing to air pollution.

Gujarat accounts (November 2020) for 10.09 *per cent* of the total thermal power installed capacity of India and has 47 TPPs of different installed capacities. In January 2010, the installed capacity of TPPs in the State was 10,590.85 MW (including gas based) which increased to 23,347 MW (by 119 *per cent*) in November 2020. Out of this, 16,761.04 MW was from coal and lignite based.

To address the air pollution due to TPPs, the Ministry amended (December 2015) emission standards and made them more stringent. The old and revised emission standards for TPPs are shown in **Table 9** below:

Table 9: - Standards for emission for Thermal Power Plants

Year of Installation	Standards in mg/Nm^3			
	PM	**SO_2**	**NOx**	**Hg**
Before 31-12-2003	100	600 for <500MW 200 for ≥500MW	600	0.03 for ≥500MW
After 01-01-2004 & Up to 31-12-2016	50	600 for <500MW 200 for ≥500MW	300	0.03
On or after 01-01-2017	30	100	100	0.03

(Source: Ministry notification of December 2015)

The TPPs were required to attain revised standards by December 2017. An action plan for the adoption of Flue Gas De-Sulphurisation (FGD) technology in TPPs was initiated by the Ministry of Power, GOI which suggested installation of the FGD in phases for SO_2 reduction to be completed by 31 December 2022 by all the TPPs. For NO_x reduction, a change in the design of the burner was to be adopted by December 2022.

[1] Report (Policy brief) of Centre for Science and Environment on using the National Clean Energy Fund to clean Coal Power Plants, 2017.

Case study of Mundra, Gujarat

Mundra located in Kachchh district has 14 units of coal base TPPs having total installed capacity of 8,620 MW which is 37 *per cent* of the total installed capacity of TPPs of Gujarat (November 2020). These units were commissioned between August 2009 and March 2013. The GPCB had conducted (May 2009) baseline environment quality studies through Gujarat Industrial and Technical Consultancy Organisation Limited (GITCO)[2]. The study report of the GITCO had mentioned that with the installation of TPPs in Mundra, the carrying capacity of Mundra for SPM, SO_2, and NOx would be exhausted and there would be a need to reduce the pollution level. Satellite imagery (by NASA) of SO_2 emission of 2016 over India showed that a high concentration of SO_2 was occurring over the Mundra Region. As per another study, based on data obtained from the Tropomi[3] for the period from February 2018 and May 2019, Mundra is the worst NO_X hotspot contributing hugely to air pollution. Thus, with the installation of 8,620 MW TPP in Kachchh, Air pollution has increased substantially and needs intervention like equipping units with FGD.

7.1 Status of Flue-gas desulphurisation installation in TPPs

Of the 47 TPPs units in Gujarat, three units were equipped with FGD[4], two units have compatible technology (CFBC Boiler)[5] and seven units required up-gradation of Electrostatic Precipitator. The remaining 35 units required installation of Flue Gas De-Sulphurisation (FGD). It was observed (June 2021) that out of 35 units, feasibility study was in progress for installation of FGD in three units, Letter of Intent was issued in case of 15 units, and in the remaining 17 units, tendering process was ongoing. Looking at the pace of installation of FGD, its commissioning may not be achieved by the due date of December 2022.

The emissions due to TPPs is a matter of concern. Audit is of the view that the timeline for installation of FGD should have been adhered to.

7.2 Emissions due to coal-based v/s natural gas-based TPPs

Audit worked out emission load per annum (in MT) per million units based on the GPCB's Environment audit reports for the year 2017-18 of the coal-based TPP, Wanakbori, and natural gas-based power plant, Kawas (Surat), (owned by the NTPC Limited), and observed that the gas-based power plant causes less emission/pollution load compared to the coal-based thermal power plant as shown in **Table 10** below: -

2 A premier Technical Consultancy Organisation that provides consulting services to accelerate the growth of industrial and services economy of Gujarat.

3 The Tropospheric Monitoring Instrument (TROPOMI) is the satellite instrument on board the Copernicus Sentinel-5 Precursor satellite.

4 Units 7,8 and 9 of AP(Mu)L.

5 Two units of Gujarat State Electricity Corporation Limited at Bhavnagar.

Table 10: - Emission load of Gas and Coal based Thermal Power Plant

Description	NTPC, Kawas (Gas base)	Wanakbori TPS (Coal base)
Total emission load (MT/ Day)	22.63	323.55
Total emission load per annum in MT	8,259.95	1,18,095.75
Total energy production in Million Unit in 2017-18	2,405.84	7,704.00
Emission load per annum in MT per Million unit	3.43	15.33

(Source: - GPCB Environment Audit Report for 2017-18)

Thus, natural gas power plants generate much less emission as compared to coal-based power plants. A study conducted by the National Environmental Engineering Research Institute on behalf of the Ministry of Statistics and Program Implementation on environmental aspects highlighted that the health effects attributable to NOx from a natural gas plant even within a two-km radius are negligible. The study further indicated that 6.5 *per cent* of the population living within a two-km radius of a coal-based thermal power plant suffer from respiratory disorders. In response to the audit query, the GPCB stated (December 2019) that no such study was undertaken by them to assess the emission impacts of coal-based and gas-based power plants.

Audit considers that as the gas based TPP is more environment friendly, policy intervention for the promotion of the same would be desirable.

The State Government may consider promoting multi-fuel technology for power generation to meet demand for power in view of air pollution caused by coal-based thermal power plants.

7.3 Installation of Flue-gas desulphurisation technology in Captive Power Plants

The new emission norms notified by the Ministry in December 2015 were also applicable to 84 Coal Based Captive Power Plants (CPP) of Gujarat. After consultations with Industrial Associations and Technology Providers for implementation of FGD and other technologies to meet new emission norms in CPP, the CPCB fixed (April 2018) the following timelines for implementation of new emission norms: -

- CPPs based on Fluidized Bed Combustion boilers were required to comply with new emission norms for PM and SO_2 by December 31, 2018.
- CPPs are required to install FGD shall comply with new norms for PM by December 31, 2018, and SO_2 by June 30, 2020.
- CPPs commissioned before December 31, 2003, were required to achieve NO_x emission of 600 mg/ Nm^3 by December 31, 2018.
- CPPs commissioned between January 2004 and December 2016 were required to comply with the NOx emission limit of 300 mg/ Nm^3 by June 30, 2020.

Audit observed (March 2021) that GPCB has no database/information regarding compliance with the timelines fixed by the CPCB despite the deadlines getting over. This indicates lack of follow-up and ineffective monitoring mechanism in GPCB.

Government stated (January 2022) that the CPCB directly monitors implementation of norms of installation of FGD.

Reply is not convincing as GPCB was required to monitor compliance by the CPPs as they fall under its jurisdiction.

The GPCB may follow up the compliance with the CPCB's directions and monitor the progress of installation of FGD in CPPs.

7.4 Non-inclusion of emissions due to TPPs in the Air Action Plan of Ahmedabad and Surat

On the intervention of the NGT, the GoG prepared (February 2019) Air Action Plan for Ahmedabad and Surat which was approved by the GoI in April 2019. In Ahmedabad city, Torrent Power Limited (TPL) is operating a coal-based thermal power plant of 362 MW.

However, while preparing the Air Action Plan for Ahmedabad city, emissions due to TPL which contributes significantly (66 *per cent*) to the total ambient air pollution was not considered by the GPCB. Similarly, fossil fuel based TPPs of a total 500 MW capacity were also operating in and around Surat but emission load due to these TPPs was not considered in the Air Action Plan of Surat.

GPCB stated (June 2021) that the Source Apportionment Study (SAS) of Ahmedabad city was being done by the Gujarat Energy Management Institute (GEMI). Based on the outcome of the study, if required, emissions caused due to TPL will be included in the Plan.

Government also stated (January 2022) TPPs are part of an action plan of the Ahmedabad and Surat cities as the industrial source and the format provided by CPCB for the preparation of the Air Action Plan of the city had not envisaged separate inclusion of TPPs as an individual entity.

The reply is not convincing as SAS of Ahmedabad city prepared by the GEMI in 2018-19 mentions that the total emission load (PM, NOx and SO_2) of Ahmedabad city in 2018-19 was 69,123.17 kg per day of which TPL alone contributed 45,794.66 kg per day (66 *per cent*). No justification for non-inclusion of emission due to TPPs in the Air Action Plan of Ahmedabad was found on record.

The non-inclusion of a major source of air pollution in the Air Action Plan may have an impact on designing mitigation measures.

7.5 Air pollution due to fly ash

Fly ash is a by-product generated from the coal burnt in a TPP and it includes all types of ash generated in TPPs such as Electrostatic Precipitator (ESP) ash, dry fly ash, bottom ash, pond ash and mound ash. Fly ash is one of the major contributors to particulate matter, a major pollutant around thermal power plants, and contributes around 26 *per cent* of PM_{10} and $PM_{2.5}$, in summer[6]. TPPs generate large quantities of fly ash which require large areas as landfills or ponds for their disposal. Fly ash becomes dry as temperature increases and gets airborne causing fugitive emission. As fly ash contains toxic and heavy metals, it pollutes air and water too. Apart from causing various diseases, it also leads to a reduction in the recharging of groundwater.

However, fly ash is an excellent construction material source for brick making, road and embankment construction, etc. Over the years, huge stocks of fly ash have stockpiled in the ash ponds due to a lack of timely and effective disposal. To save scarce land resources of ash ponds and to control fugitive emissions, the Ministry (September 1999) fixed August 31, 2007, as the deadline for 100 *per cent* utilization of fly ash which was further extended to December 31, 2017, with the following stipulations for its utilization:

(i) Every agency engaged in construction activity within a radius of 300 km of coal-based thermal power plant must use ash-based products for construction.

(ii) The transportation cost of (a) ash used in road construction, manufacturing of ash-based products or use as a soil conditioner in agricultural activity within the radius of 100 km of any coal-based thermal power plant and (b) ash used in road construction projects under Pradhan Mantri Gramin Sadak Yojna, construction of Government buildings, dams, and embankments within the radius of 300 km of the power plant will be borne by the power plant.

(iii) Mandatory use of fly ash-based bricks or products in all government schemes and programmes such as MGNREGA, Swachchh Bharat Abhiyan, urban and rural housing schemes where the built-up area is more than 1,000 square feet, and in infrastructure activities in designated industrial estates, parks, and special economic zones.

(iv) Use of fly ash for filling the low-lying land as part of reclamation projects and in backfilling of mine voids.

Audit reviewed the records regarding the handling of fly ash by TPPs and its monitoring by GPCB and observed the following: -

7.5.1 Non-Disposal of legacy stocks of fly ash

In November 2020, coal and lignite based TPPs with a total generating capacity of 16,761.04 MW were functional in the State, thereby generating a huge

[6] Media Report of The Economic Times Titled as "Here's a lesser- known reason behind air pollution" which was based on Report of Indian Institute of Technology, Kanpur.

quantity of fly ash. The disposal of fly ash during 2014-15 to 2020-21 in the six TPPs test checked by Audit is shown in **Table 11** below:

Table 11: - Fly ash Generation and disposal (in lakh ton)

Name of TPP	Opening balance as of 1st April 2014	Fly ash generation during 2014-15 to 2020-21	Fly ash disposal during 2014-15 to 2020-21	Closing balance as of 31st March 2021
GSECL, Gandhinagar	100.87	40.48	83.89	57.46
GSECL, Wanakbori	371.49	104.67	94.86	381.30
GSECL, Jamnagar	22.25	7.52	20.18	9.59
TPL, Ahmedabad	8.45	23.34	21.77	10.02
CGPL, Mundra	6.97	52.13	41.51	17.59
Adani Power Ltd	4.98	66.56	66.11	5.43
GSECL, Ukai	NA	NA	NA	129.55
Total	**515.01**	**225.55**	**328.32**	**610.94**

(Source: Information furnished by GPCB)
NA – Not available.

As could be seen from the above, 610.94 lakh tons of fly ash were required to be disposed of in an environment-friendly manner as of March 2021. The huge stock of fly ash indicates that the Ministry's stipulation of 100 *per cent* disposal of fly ash by December 31, 2017, could not be met. Huge quantity of legacy fly ash with GSECL plants at Ukai and Wanakbori required Government interventions. However, there was a reduction in the overall legacy quantity of fly ash of the TPPs located at Gandhinagar and Jamnagar. CGPL submitted (January 2018) a plan to GPCB for disposal of legacy fly ash but it could not dispose of the same.

The CPCB imposed (July 2020) an Environmental Compensation of ₹ 3.57 crore on five TPPs in pursuance of the NGT order dated 12 February 2020**,** due to the non-disposal of 100 *per cent* fly ash.

7.5.2 Non-compliance of Regulations on dumping of fly ash

The TPPs are required to submit details of fly ash utilization on annual basis to the Ministry. All the TPPs of the State except GSECL-Wanakbori and CGPL-Mundra were reporting 100 *per cent* utilization of fly ash. Audit observed that the data shown by the TPP were of the utilization of ESP fly ash whereas utilization of legacy stock of fly ash lying in their ash pond was not included in reports.

For dumping of fly ash in low laying area, GPCB accords prior permission keeping in view compliance with SOP and Environmental safety. Audit examination of reported details of fly ash utilization by following three TPPs revealed that these TPPs were dumping fly ash in low lying areas without the permission of GPCB. This is discussed as under: -

Torrent Power Limited, Ahmedabad

- Total quantity of undisposed fly ash (pond ash) with the Torrent Power Limited, Ahmedabad (TPL) was 8.45 lakh MT in April 2014 which increased to 10.87 lakh MT in March 2019. However, TPL reported 100 *per cent* utilization of fly ash in 2017-18.

- Between 2014-15 and 2018-19, TPL, Ahmedabad, reported disposal of 16 lakh MT of fly ash. Audit scrutiny revealed that out of this, the TPL had dumped 1.92 lakh MT fly ash at four different sites (farmlands near Gandhinagar city and at the bank of Sabarmati River) during 2014-15 to 2018-19 with the consent of landowners.

- After being pointed out in audit, GPCB monitored these four sites in September 2019 and observed that at one of these sites, fly ash was dumped in adjoining land towards riverbank without protection wall and ash spread towards the river bank due to rain. At two other sites, fly ash was dumped for levelling of land. The remaining site was surrounded by residential and commercial areas and dumped ash was not covered and levelled.

- GPCB issued show-cause notice (January 2020) to TPL after four months. TPL had not furnished specific compliance to dumping of fly ash in violation of the Ministry's notification. No action has been taken by GPCB against TPL (June 2021).

Adani Power (Mundra) Limited, Mundra

- Filling low-lying areas with fly ash requires prior approval of GPCB. The Adani Power (Mundra) Limited (APL) utilized 15.42 lakh MT fly ash for filling low-lying areas between 2014-15 and 2018-19 without the approval of GPCB and reported 100 *per cent* utilization. Further, the Ministry directed (March 2016) APL to install an online monitoring system in the plant premises and at locations of fly ash disposal to capture and report data. However, no such system was installed (December 2021) by the APL.

GPCB did not take any action against APL for dumping the fly ash in the low-lying areas without its approval and for incorrect reporting of 100 *per cent* utilization of fly ash**.**

Coastal Gujarat Power Limited (CGPL), Mundra

- As per the conditions of EC, CGPL was to achieve 100 *per cent* utilization of fly ash by March 2016 but it could not achieve. Therefore, CPCB directed (March 2017) CGPL to submit an annual implementation plan. The GPCB also issued directions (March 2018) to the CGPL to achieve 100 *per cent* utilization of fly ash as during site visit (January 2018), GPCB had observed 16.39 lakh MT ash pond and 1.50 lakh MT fly ash in stock.

- Audit observed that the CGPL had dumped 0.796 Lakh MT fly ash in low-lying areas within the plant premises during 2018-19 though as per EC order, there was no such low-lying area within the plant premises. Further, the CGPL did not obtain permission from the GPCB for the dumping of the fly ash in the low-lying area.

- GPCB confirmed (June 2021) that the CGPL was not complying with fly ash rules and regulations and the RO had proposed suitable action against CGPL which was under the process for necessary approval.

Thus, the GPCB has not taken stringent action against these TPPs for dumping of fly ash in low lying areas without its permission.

7.5.3 Non-compliance of GoI regulations for the utilization of fly ash

Ministry directions (November 2009) for utilization of fly ash stipulate that the CPWD, Public Works Department in States, National Highway Authority of India (NHAI), and other constructing agencies including those in private sectors shall prescribe the use of ash and ash-based products in their respective tender documents, schedule of specifications, *etc*, within four months. The directions also included the constitution of the State Level Monitoring Committee (SLMC). The Ministry also notified minimum fly ash content for building materials or products and mandatory use of fly ash-based bricks in cities having a population of one million or more by amending Building Bye-laws by the State Authorities. The GoG constituted the SLMC in December 2014.

Road and Building Department (R&B) included provision for use of fly ash-based items in the Schedule of Rates (SOR) on the directions (July 2015) of SLMC. The R&B Department also informed that it had not been able to enforce the provision for use of fly ash due to resistance from the contractors. In this reference, Audit called (April/May 2019) for details of utilization of fly ash and inclusion of fly ash-based items in SOR. Three R&B circles confirmed that fly ash was not being used in Government funded public works except those used in the construction of Mahatma Mandir, Gandhinagar in 2014-16.

Audit examination of records revealed that the R&B Department had not included fly ash-based items in their SOR, though they confirmed it in the SLMC. Audit noted that the CPWD, Gandhinagar, and NHAI have included fly ash-based items in their SOR and the tenders. As per the data submitted by the Regional Officer, NHAI, Gandhinagar, the NHAI had already utilized 12.03 lakh MT fly ash in their road widening projects[7] and made provisions for utilization of 37.32 lakh MT fly ash in the estimates of ongoing six works in the State. Audit noticed that though, R&B Department was executing similar types of road works, it had not made provision for mandatory use of fly ash in their works.

As per Ministry's directions, the bricks manufactured from fly ash are to be used mandatorily for buildings in cities with population of one million or more. The Ministry assigned the responsibility for implementing its directions to the Urban

[7] Chiloda- Himmatnagar six laning project of National Highway Authority of India.

Development and Urban Housing Department of the State Government. The policy of using fly ash for building materials is already in place as per Ministry's directions. Though the fly ash-based bricks are used in private construction, the intervention of Urban Development and Urban Housing Department would provide further impetus to the use of fly ash-based bricks in the Government financed works.

The GPCB stated (June 2021) that the matter was taken up with the R&B Department and Urban Development and Urban Housing Department in December 2017 and February 2021, and their responses were awaited (January 2022).

Audit observed that non-compliance by the State Government Departments violated the Ministry's directions.

The State Government may direct its different departments such as Roads and Buildings, Urban Development and Urban Housing, Panchayat and Rural Housing, etc. to coordinate with Brick kilns to promote use of fly ash in their construction and allied activities.

The State Government may also frame a policy to encourage use of fly ash-based bricks and other building materials.

Government stated (January 2022) that Gujarat is one of the pioneer state in the utilization of fly ash in the cement industry and all efforts were being made to ensure that fly ash is disposed of in an environmentally sound manner**.** Though, there has been sincere attempts to utilise fly ash, there was a huge stock of legacy fly ash of 610.94 lakh MT with the TPPs.

Conclusion

Gujarat houses 47 TPPs units and its share in thermal power generation in national contribution stands at 10.09 per cent. As coal based TPPs contribute disproportionally higher to emission than emission due to industries, these TPPs are a major source of air pollution. These TPPs required the installation of FGD by December 2022, which is not likely to be achieved. Non-disposal of legacy stock of fly ash and non-compliance with norms on the utilization of fly ash caused fugitive emission. There is a lack of emphasis by the various line departments on use of fly ash.