Meeting New Environment Norms for Thermal Power Generation – A Challenge

Date: 22nd April, 2016

PROCEEDINGS OF EEC SEMINAR

INTRODUCTION

The Excellence Enhancement Centre organized a Seminar on "Meeting New Environment Norms for Thermal Power Generation – A Challenge" on 22nd April, 2016 at IHC, Lodhi Road, New Delhi

Delegates from various generating organisations such as NTPC, NLC, Tata Power, TANGEDCO, MAHAGENCO, TSGENCO, APGENCO, Chhattisgarh, CESC, DVC, NSPCL, GSECL, ACB India, RVUNL, PSPCL, HPGCL, OPGCL, JSW, Gayatri Power, NSL Nagapatnam Power & Infratech Pvt. Ltd. etc., participated in the seminar. Also delegates from various manufacturers such as BHEL, L&T, STEAG, Doosan, GE-Alstom, ANDRITZ, Hamon Research Cottrell, KC Cottrell, Toshiba, Thermax and MHPS participated. The representatives of Central Government Departments including MOP, CEA, CPRI, CPCB were present during the seminar. The other organizations like CBIP, TERI, Lahmeyar, Black & Veatch etc. also participated in the seminar.

About 200 numbers of participants attended the seminar. 15 Nos. of technical papers were presented and discussed during the seminar.

NEW EMISSION NORMS (AS NOTIFIED ON 07.12.2015)

Emission Parameter	TPPs (units) installed before 31st Dec. 2003	TPPs (units) installed after 31st Dec. 2003 and up to 31st Dec. 2016	TPPs (units) to be installed from 1st January 2017
Particulate Matter	100 mg/Nm^3	50 mg/Nm^3	30 mg/Nm^3
Sulphur Dioxide (SO_2)	600 mg/Nm^3 for units less than 500MW capacity 200 mg/Nm^3 for units 500MW and above capacity	600 mg/Nm^3 for units less than 500MW capacity 200 mg/Nm^3 for units 500MW and above capacity	100 mg/Nm^3
Oxides of Nitrogen (NO_x)	600 mg/Nm^3	300 mg/Nm^3	100 mg/Nm^3
Specific Water Consumption Limit	Cooling Tower (CT) to be installed in place of once through cooling (OTC) and Water Consumption upto Max 3.5 m^3/MWh Water Consumption of upto Max. 3.5 m^3/MWh for all existing CT based plants.		Maximum water consumption of 2.5 m^3/MWh and zero waste water discharge
Mercury	i. TPP (Units) installed before 31st Dec., 2003 (500 MW and above capacity) ii. TPP (Units) installed after 1st January, 2003 up to 31st Dec., 2016 iii. TPP (Units) installed from 1st January, 2017		0.03 mg/Nm^3

These norms are mandated to be complied within 2 years by all existing units of Thermal Power Plants (TPPs) and from 01.01.2017 by all new units of TPPs.

CAPACITY COVERED

UNIT WISE BREAK UP OF COAL BASED CAPACITY (MW)

Unit Size	Installed Before 31.12.2003		Installed After 31.12.2003	
	No of Units	Total Capacity (MW)	No of Units	Total Capacity (MW)
Up to 250 MW	313	47,628	112	19,214
From 250- 500 MW	27	13,500	53	17,290
More than 500 MW	-	-	148	87,640
Total	340	61,128	313	1,24,144
Total Mar, 2016	Units-653 Capacity 1,85,272 MW (Coal)			

MAIN TECHNOLOGIES FOR SOX, NOX AND PARTICULATE MATTER (PM) CONTROL

Flue-gas desulfurization (FGD)
- Wet Lime Stone Process
- Spray Dry Scrubber
- Sea Water Scrubbing

Denitrification System
- Combustion Control
- Selective Catalyst Reduction (SCR)
- Selective Non-Catalyst Reduction (SNCR)

Particulate Matter (PM)
- ESP
- Bag Fabric Filter
- MEEP Technology for ESP

TECHNOLOGY OPTIONS FOR DIFFERENT UNITS

Units Installed before 2003

SO_x (600/200 mg/Nm^3)
- Unit capacity 250 MW or less and with limited residual life, the option of fuel modification (Sulphur content less than 0.2%) can meet these limits.
- 500 MW and above with space availability the Wet/Dry FGD technology option is available.

NO_x (600 mg/Nm^3)
- With installation of efficient low NOx burner the limit of 600 mg/Nm^3 is achievable.

PM (100 mg/Nm^3)
- Additional ESP fields or fabric filters in series
- Low temperature high efficiency ESP by installing heat exchanges at inlet and outlet of ESP
- Replacing last 2 static fields of ESP with moving electrode ESP
- Flue Gas conditioning

Units Installed between 2003-16 and beyond

SO_x – 600/200/100 mg/Nm^3
- Units with capacity 500 MW or above mostly have space provision for installation of Wet / Dry FGD system.
- Units with capacity less than 500 MW, space constraint to install the Wet/Dry FGD system may lead to non-feasibility.
- Units with capacity 250 MW or less fuel modification can meet 600 mg/Nm^3 units

No_x – 300/100 mg/Nm^3
- Some of technology provider have confirmed that low NOx burner technology can achieve the levels in the range of 300 mg/Nm^3.
- SNCR is placed at furnace outlet and requires modifications in boiler for the retrofit of ammonia injection system. Maintenance issues at temperature above 800°C and operational problem with downstream equipment are anticipated as control of ammonia injection & distribution of ammonia at higher temperature is problematic. Further globally SNCR is employed at lower unit size up to 200 MW and its performance for 500/660/800 MW is yet to be established.
- SCR is the other options though costly with no experience with Indian coal.

PM (50/30 mg/Nm^3)
- Presently most of the units are designed for an emission of 50 mg/Nm^3.
- Where units are designed for higher emission, the technology option mentioned before are available.

ISSUES AND CHALLENGES

A. SO_x

- About 80000 MW of total installed capacity of less than 500 MW units will be affected due to non-availability of space for FGD installation.
- Even where space is available, Flue Gas Desulphurisation installation may take around 2 to 3 years and involve plant shutdown of 4-6 months. Dismantling / Relocation of existing plant facilities may be required in certain cases, affecting plant operation resulting in loss of generation.
- Installation of FGD on over 2 lakh MW capacity would need limestone of around 24 MTPA and produce 34 MTPA of gypsum. These figures would progressively increase with increase in FGD installations.
- Disposal of gypsum in environmentally friendly manner.
- Marketing avenues of gypsum. Some utilities having installed FGD are already facing problems of gypsum disposal
- The Auxiliary Power Consumption shall increase for FGD operation by 1.0-1.5% affecting the plant efficiency.
- The mining capacity of limestone in the country and its transportation to plants and associated challenges need to be addressed.
- Quality of Indigenous Lime Stone / suitability or arrangements for its import.

B. NO_x

- Installations of Selective Catalytic Reduction (SCR) systems and associated issues.
- Combustion control system modification may lead to NOx levels of around 600-700 mg/Nm^3
- The NOx emission limits of 300 mg/Nm^3 & 100 mg/Nm^3 cannot be easily met without installation of SCR System. Some technology provider claim to have achieved levels in the range of 300 mg/Nm3 with low Nox burner technology.
- Globally available SCR system for reducing NOx emissions are not proven for Indian coal having high ash contents. No proven and established control technology suited to our high ash Indian coals exists and pilot studies needed before deploying any technology.
- Installation of DeNOx system in the existing units shall be a difficult task in view of the lay-out issues.
- Installation of SCR systems require extensive change in duct work, change of ID fan etc. for which no provision has been kept in the existing plants.
- Consumption of about 2500 tons ammonia per year for a 500 MW unit, its availability, transportation, handling & storage at plants.
- Environmental hazards of Ammonia.
- Catalyst for the SCR system is very expensive and has limited life (around 3 years).
- Impact on O&M charges and increased power consumption due to increased pressure drop in the system.

C. Vendor Availability

- Biggest constraint of Indigenous Vendor availability even if technical feasibility exists
- FGD & DeNOx systems have to be initially imported from other countries as the same is not being regularly manufactured indigenously.
- Installation @ 20,000 MW / annum in about 2,66,000 MW capacity (1,85,272 existing+ 80,800 MW under construction) would take more than 10 years.

D. Other

- Limited time period for implementation for new and old plants.
- Newer plants might get delayed due to the non-compliance of new norms.
- The expected capacity may not come to the grid affecting power supply and financial hardship to stations.
- Some of the power utilities have raised their concerns and expressed their difficulties about the implementation of new environmental norms.
- Two years is not sufficient for implementation in view of time required for Design and Engineering, approvals, arrangement of funds, tendering and erection, testing & commissioning.
- The impact on power supply position due to closure of most of coal based capacity (due to non-fulfilment of environmental norms), as the modifications/retrofits would require long shut downs of units.
- Units operating at very low PLF or have intermittent/ seasonal plant operation cannot recover the huge investment made, in their remaining life span without a steep rise in power tariff.
- The implementation will have to be staggered for plant units to ensure power supply.
- Units under advanced stage of installation, the environmental control systems would have to be considered only as retrofits.
- Holding back commissioning of the units on account of environmental Standards may not be advisable as it could lead to contractual issues with equipment suppliers, establishment of guarantees etc.

- Delayed commissioning may lead to performance guarantee issues in the equipment later.
- Commensurate plans would have to be taken up by other Organization/Govt. Deptts. for mining of limestone, transportation of gypsum of requisite quality and handling ammonia & environmental approval thereon.
- CAPEX of around Rs. 1.0 Cr/MW (Rs.0.5 Cr/MW for FGD, 0.4 Cr/MW for SCR) and OPEX would have to be allowed by the Regulators in tariff which ultimately would burden the consumers.
- Huge capital requirement in the next two years to make the coal based power plants compliant with new norms.
- Modification of existing PPAs to include revised tariffs
- Due to limited supply of DeSOx systems and no supplier for proven DeNOx system, excessive outflow of foreign exchange shall take place. Also prices could escalate due to simultaneous requirements from large number of power utilities.
- As a rough estimate the power tariff may increase by 45 to 55 paise/kWh.
- Steep rise in tariff for 15-20 years old plants, as it would not be possible to recover the investment in their remaining life span.

E. Water Systems

- The specific water consumption of 3.5 m^3/MWh is feasible and can be attained by taking suitable water conservation steps. Difficult to maintain the same in case of low PLF/ intermittent plant operation or increased salinity in supply water. Water consumption for smaller size units and older units may be more than 3.5 m^3/MWh.
- Additional water will be required for the operation of FGD system which would be required to be installed by plants for SOx control. As such the norms of specific water consumption of 2.5 m^3/MWh needs to be enhanced to 3m^3/MWh.
- Conversion of once through cooling water system (OTCW) to closed cycle cooling system in existing plants is a difficult proposition in most plants as there would be no space for installation of cooling towers and re-routing of CW pipelines etc. The retrofit will require large space for construction of raw water reservoir and installation of cooling towers, new CW pump house, laying of CW ducts, cooling water treatment system, side stream filters and possible condenser replacement etc. which is unlikely to be available in existing plants. Typical land requirement for conversion of 2x500 MW plant size to close cycle with Induced draft cooling Towers is about 65 acres and with natural draft cooling Towers is about 80 acres. Additional capex of Rs.0.3 to 0.4 Crores/ MW and auxiliary power consumption of 0.6% will be required apart from increase in O&M cost.
- The retrofit to closed cycle cooling tower based system, the net plant consumptive water on this account will increase due to total evaporation from surface of raw water reservoir and evaporation & drift loss from cooling tower as compared to evaporation from surface of water body in once through cooling system.
- The turbine efficiency depends upon condenser vacuum which in turn depends upon cooling water temperature. Cooling water temperatures are lower in case of open cycle using Once Through Cooling system. Conversion to closed cycle cooling shall reduce the turbine efficiency by around 2% with consequent increase in coal consumption & emissions.
- In case of sea water cooling with cooling towers (CT), the maximum COC of 1.5 is achievable due to high concentration of Total Dissolved Solids (TDS) in sea water resulting in water consumption of more than 8.0 m^3/MWh. Therefore, sea water based power plants cannot meet the new water norms. Insistence on present norm regarding water consumption would ultimately require shut down of all coastal plants. This aspect needs to be addressed in the new environment norms.
- Sea water based FGD is considered to be most viable option in coastal plants and OTCW system would require to continue for the same or alternatively drawl of about 100 m^3/MWh of sea water for FGD operation would have to be allowed in Closed Cycle system. This aspect needs to be addressed in the new environmental norms.

F. Mercury

- Globally, no mature technology is available for control of mercury. However, the emission of mercury can be restricted through other pollution control equipment's like ESP, FGD and SCR etc. as a co-benefit.

G. For Plants Under Construction

- More than 80,000 MW coal based capacity is under construction which is at various stages of completion.
- The power plants under construction have already firmed up their plant specifications and configurations based on the prevailing environmental norms & environment clearance issued and placed the order to the contractors based on the same. Any modifications to augment the ESPs or installation of FGD and SCR systems or changes in cooling system may not be practical at this stage as it require huge changes in design and lay-out. This will result in increased project cost and consequential delays in these projects. This would also create contractual issues due to change in scope of work after award of contact.
- For the units which are under construction and are likely to be commissioned after 01.01.2017 the time left is less

than one year, in which it is not possible to carry out the retrofitting of the pollution control systems. Such units if not allowed to operate on environmental grounds then this additional capacity is not likely to supply power to the grid. Also non- operation of these units would lead to contractual issues regarding demonstration of guarantees etc. Further, if the units are not allowed to operate for 1-2 years (till FGD/SCR systems are installed) then it may severely hamper the operability of the units.

SUGGESTIONS

- Pilot studies for technology suitability for SCR systems (NOx) with Indian coal – new and retrofits
- Stations specific studies for SOx control systems
  - i. Configurations
  - ii. Space requirements for different areas/systems
  - iii. Modifications etc. in other stations systems
  - iv. Additional water consumption and treatments / disposal
  - v. Definitive cost and time estimates
- Such measures would help utilities in devising stations specific strategies for implementation
- Assessment of Limestone availability & transport logistics and Gypsum disposal avenues
- Sea Water based plants should be permitted to have
  - i. Once through cooling system
  - ii. Sea Water based FGD system

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EXCELLENCE ENHANCEMENT CENTRE (EEC) for Indian Power Sector was conceptualized as a part of bilateral cooperation between Govt. of India and Govt. of Federal Republic of Germany and was set up through an Implementation Agreement between BEE & CEA, Ministry of Power, GOI and GIZ, Germany under the Indo German Energy Programme (Phase-II), to promote dialogue in the area of Energy Efficiency and Energy Security. It was registered as a non-profit society under the Indian Societies Registration Act 1860 and started functioning from February 2012.

Aims and Objectives of EEC

- To provide a platform for the top Experts in Power Sector.
- To share best practices.
- To identify challenges.
- To create a "Technical Discussion Forum".
- To promote Peer to Peer cooperation between Indian Power Sector Stakeholders.
- To promote policy initiatives of MOP, GOI
- To raise awareness for the need of excellence in Power Sector

Activities of EEC

- Making EEC more broad based
- Organizing an EEC Conference on annual basis
- Conducting 4-5 workshops every year
- Conducting 4-5 training programs every year
- Facilitating Knowledge Exchange
- Facilitating Technical Advice / Consultancy services
- Taking up Technical studies
- Creating an Archive of Best Practices,

Governing Body of EEC*

President - Chairperson, CEA
Vice President - Member (Thermal), CEA
Member & Treasurer - Secretary, CBIP
Member - Director General, BEE
Member - Director (Technical), NTPC
Member Secretary - Chief Engineer (TPE&CC), CEA
Member - Dr. Ajay Mathur, Director General, TERI
Member - Dr. Winfried Damm, Director - IGEN, GIZ
Member - Dr. J.T. Verghese, Chairman, STEAG
Member - Shri D.K. Jain, Former Director (Tech.), NTPC
Member - Shri O.P. Maken, CEO, EEC

* Likely to be expanded to have wider representation of Power Sector Organisations

Membership Fee Structure

Category	Type of Organisations	Fees for 3 years Period**
A.	CPSUs/ IPPs/Private Sector Cos Manufacturers/Foreign Registered Companies (with gross annual turnover of more than 5000 Crs.)	₹ 15 lakhs
B.	• CPSUs/ IPPs/Private Sector Cos Manufacturers/Foreign Registered Companies (with gross annual turnover of Rs.5000 Crs. Or Less) • State Owned Utilities (Generation/Transmission/ Distribution/Trading)/State Boards/ Training Institute/Research Institutions/Academic Institutes/Govt. Agencies/Consultant etc. (Irrespective of turnover)	₹ 6 lakhs
C.	Individuals	₹ 6000/-

**(The 3 years period is effective from payment of membership fee)

*Service Tax extra as applicable

Benefits & Privileges of Three year EEC Membership - Kindly visit EEC Website

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