Environmental Stewardship

एनटीपीसी NTPC
A Maharatna Company

NTPC's ENDEAVOURS TOWARDS ENVIRONMENTAL STEWARDSHIP

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Save
Environment
Save Future

PREFACE

NTPC lays a very strong emphasis on protection of environment, which has been engrained in every aspect of our Policy design, O&M execution and R&D endeavors.

NTPC has revised its Environmental Policy in 2017 to contribute to greater commitment and sharper focus on environmental stewardship. NTPC is regularly upgrading its power stations for maintaining the emission parameters as per the specified norms of regulatory bodies and ensuring highest possible energy conversion of electricity.

NTPC is also one of the first companies in India, and very few globally, to have come out with a dedicated Water Policy, recognising the importance of this very precious resource. Minimizing water consumption and maintaining the right quality of water is at the center-stage of the policy.

Ash utilization is considered an integral part of process of power generation and we make all efforts to maximize our ash utilization towards 100% on sustainable basis. NTPC has a well-defined 'Ash Policy'. Ash Disposal/Utilization also continues to remain key concern amongst all stakeholders. NTPC is facilitating a lot of R&D woks and investing heavily in the area of ash Utilization.

NTPC is also committed to conserve the biodiversity of the planet. We are developing a Biodiversity Policy also to bring more focus on the area. We have taken several steps to protect flora and fauna including rare and endangered species.

Moreover, aligned to our target of becoming 32 GW renewable company by 2032, our installed capacity of solar power has been on increasing trend. Presently, renewables constitutes about 1.7 % of our total energy portfolio.



Environmental Stewardship

We have dedicated functional groups like Centre for Power Efficiency & Environmental Protection (CenPEEP), NETRA in addition to corporate departments such as Environment Management Group and Ash Utilisation for planning and executing the tasks pertaining to environmental stewardship. To achieve environmental goals and ensure continuous improvement in environmental performance, our stations are certified with Environment Management Systems (EMS).

MESSAGE from CMD

MESSAGE

Energy and environment are closely interlinked. Every form of energy is either derived or captured from the environment and is eventually returned to the planet as by-product(s) or as harmful emissions or waste. NTPC, one of the world's largest electricity producers and an environmentally responsible company recognizes its dependence on environment and is committed towards its conservation.

Since inception, NTPC has been focusing on improving fuel efficiency and cutting emissions and over the years we have grown more sensitive towards environment with changing business landscape. We have internalized the United Nations' Sustainable Development Goals (SDG) and India's INDC commitment towards climate change mitigation in our business activities. Reduction of emission intensity, increase of portfolio and capacity of renewables, addition of carbon sinks through tree plantation are some of the notable steps in this direction. We have developed policies on environment and water to bring more focus and guidance to our units in reducing ecological footprint.

We are constantly innovating and re-engineering our processes to ensure our environmental impact is minimal. A very significant step taken by us is indigenous development of advanced ultra-supercritical technology (AUSC), which will increase the efficiency by 10 % over current conversion efficiency of 42 % from super-critical technologies. NTPC has taken many proactive steps through its R&D wing NETRA (NTPC Energy Technology Research Alliance) in exploring alternative areas of ash utilisation such as development of coarse / fine aggregates and geo polymer based concrete roads from bottom and fly ash. We have already reduced our water footprint per unit of electricity by 3.3% over previous year. To conserve surface water, we are adopting Air Cooled Condenser (ACC) at our North Karanpura and Patratu projects and also implementing Zero Liquid Discharge (ZLD) at all our stations. We have taken initiatives like 'biomass co- firing', 'waste to energy generation', paperless and e-waste free workplace.

This booklet provides a glimpse of some of the endeavours undertaken by NTPC to minimise its environmental footprint through state of the art technological interventions and process innovations. I believe this compilation of best practices will serve as a benchmark for us and also inspire all readers to put their sincere efforts in conserving the environment.

We will continue to strive to bring positive changes in our organizational behaviour, process, strategy and outlook to achieve a greener and resourceful future.

(Gurdeep Singh)
Chairman & Managing Director

Environmental Stewardship

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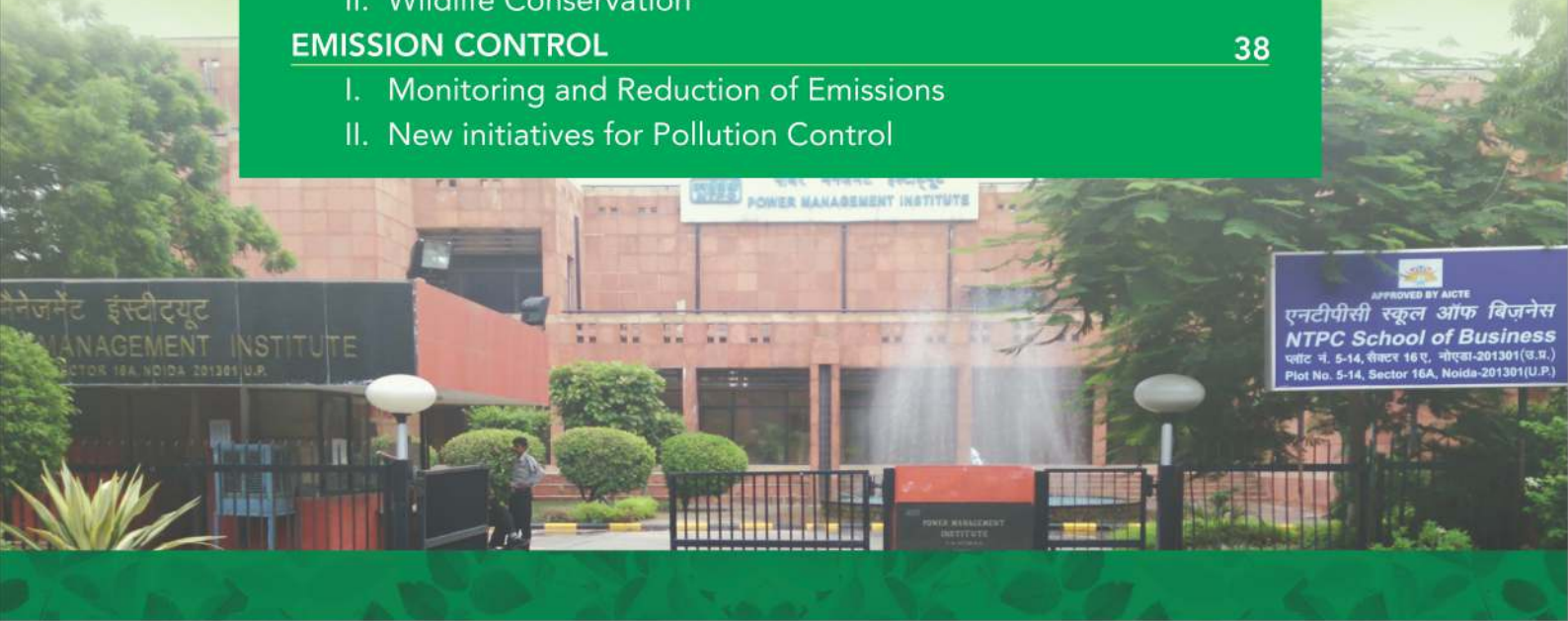


GEOLOGY
NATURAL
AIR
ENVIRONMENT
GREEN
ECO
LIFE

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NTPC ENVIRONMENT POLICY

Environmental Stewardship

NTPC has a well-documented Environment Policy 2017. Followings are the policy statement and principles (salient features) of the policy.

"To provide cleaner energy by committing to highest possible levels of performance in environmental compliance, practices and stewardship"

Principles of Environment Policy 2017

NTPC environment policy forms the base of the company's approach towards environment management. This policy is based on the following principles:

- Consideration of environmental factors right from the stage of planning, design and operation of projects to ensure that principles of conservation and sustainability are adhered to.
- Impact of NTPC's business on environment can be minimized by adopting best environment management practices and state-of-the-art technology.
- NTPC's commitment as a responsible corporate citizen is demonstrated by achieving and setting benchmarks beyond statutory compliances.
- Innovation by carrying out Research & Developmental activities, coupled with enablers leads to continual improvement.
- Accepting accountability for all operations and expeditiously respond to any aberration.
- Continuous monitoring and sharing of environmental indicators with stakeholders ensures NTPC's commitment towards continual improvement in environmental performance.
- Develop each employee as environmental steward by improving his/her awareness levels while soliciting his/her commitment.

Complete policy document is available on NTPC website : **https://www.ntpc.co.in/en/environment-policy-2017-0**

ENVIRONMENTAL COMPLIANCES & EMS STANDARDS (ISO) - A Brief Snapshot

NTPC has a legal and moral duty to comply with environmental laws and regulations. However, NTPC endeavours to go beyond compliance of environment norms.

Compliances of Environmental Clearance of various plants of NTPC are on company website for better transparency and dissemination of information to stake holders. Display of ambient air quality levels and emission levels on our various plants' main gate and their online real-time transmission to regulators like CPCB and SPCB establishes that NTPC is committed to achieve these environmental standards.

Beside the legal compliances of environmental norms, NTPC has adopted an integrated Environmental Management System (ISO 14001) for continual improvement of environment at its units. Our units derive following benefits from implementation of ISO 14001 Environmental Management System.

- Better environmental management reduces waste and energy use by monitoring and continual improvement
- Improve efficiency to cut the cost of power generation
- Demonstrate compliance to expand our business opportunities
- Meet legal obligations to win greater stakeholder and customer trust
- Continual improvement and make aware to plant management about environmental performance of its units.

Regular internal and external audits are carried out in plants. EMS legal Register/File is being maintained at our plants to record any deviation, non-compliance, inspection reports of regulatory authorities. The latest versions of ISO 14001: 2015 has been implemented at two of our stations i.e. Sipat and Rihand while other stations are in the process of rolling out the same within the stipulated time frame.


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WATER
EFFICIENCY

Towards Water Stewardship

Water is an important natural resource for every living being on earth. As a responsible corporate citizen, NTPC commits to be a flag-bearer in the field of water conservation. It has optimized its processes to increase surface water availability by following the principle of 3 Rs (Reduce, Recycle & Reuse). NTPC hereby commits to proactively address issues related to water quality and its availability by implementing the Water Policy, which serves as a directive for establishing water management strategies, planning, systems, processes, practices and research initiatives.

The following measures has been taken to optimize the water consumption process and prevent water pollution at our plants.

- High Cycles of Concentration (COC) operation in Circulating Water System
- Taking cooling water blow down from condenser outlet (hot side) instead of cold side
- Design upgradation for implementation of Zero Liquid Discharge (ZLD) system across all stations
- Improved Condensate Polishing Unit (CPU) Performance: Water saving by reducing regeneration cycle in water steam cycle of Power Plants
- High Concentration Slurry Disposal System: Water consumption is reduced by implementing HCSD System due to high concentration of ash in HCSD (60-70%) in comparison with LCSD (15-25%) in new plants
- Adoption of dry bottom Ash handling System
- Flue Gas and Solar Thermal based Sea Water Desalination Plants
- Provision of clean drinking water to people around NTPC projects
- Adoption of Rainwater harvesting System wherever feasible
- Saving of water through installation of floating solar PV plants
- Use of high efficiency Drift Eliminators in cooling towers
- Adoption of Air Cooled Condensers at upcoming stations
- Use of treated municipals sewage water for utilisation in power plant water cycle
- Online real time monitoring of effluent by Effluent Quality Monitoring System (EQMS)

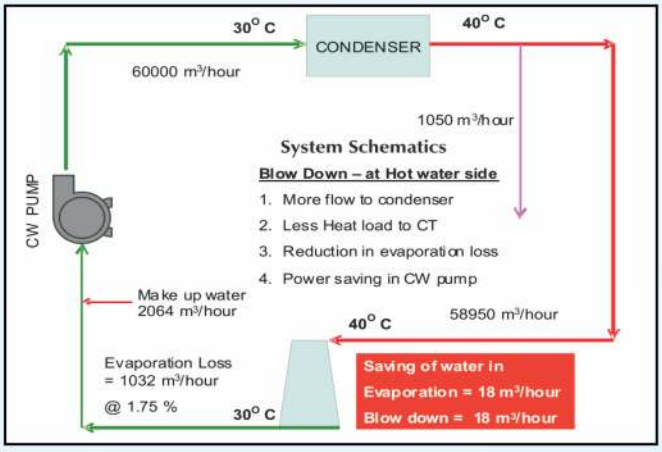
NTPC has issued a booklet on its water conservation efforts.
Detailed booklet can accessed at
http://www.pmintpc.com/pdf/Final%20Water%20Booklet%20NTPC.pdf

INITIATIVES IN FOCUS

Taking cooling water blow down from condenser outlet (hot side)

When water passes through CT, there is a loss of water by evaporation, due to which salt concentration increases. To reduce the evaporation loss we are now taking blow down water from hot side of water cycle i.e. condenser outlet instead of cold side of CW to to maintain desired Cycle of Concentration (COC).

It is estimated that the saving of make-up water will be of the order of 8-10 m3/hr at COC level of 5-6 per 500 MW unit with this practice of hot blow down. With a fleet size of 50,000 MW, this saving would be of the order of 100000 m3/day.



Design upgradation for implementation of Zero Liquid Discharge (ZLD) system

Adoption of Zero liquid discharge (ZLD) is a concept where the entire industrial and domestic waste water can be reused after treatment/recycling without discharging a drop of water outside the project boundary in the natural water bodies.

The Zero Discharge plan includes the following major system:

i) **Ash Water Recirculation System (AWRS) and Toe Drain Recirculation System (TDR):**

NTPC stations have installed AWRS and TOR for optimization of water consumption in a closed cycle and achieving the zero liquid discharge from the ash ponds. 70% of Ash handling water is recirculated back to plant from ash pond resulting in marginal make-up of only about 200-300 m3/hr for a typical 2x660 MW power station.

ii) **Liquid Waste Treatment Plant (LWTP):** The effluent generated from various sources in the plant such as Coal Handling Plant, main plant area etc, are collected to central monitoring basin of LWTP. The collected effluent is analysed for quality within the prescribed norms and reused in suitable applications.

iii) **Separate Drainage System for Storm Water and Process Water :** Separating Storm Water from Process Water, though a simple solution, goes a long way in segregating pure and contaminated water thus saving fresh water and reducing purification costs. This system will result into uncontaminated storm water which can be used as a top up water source, reduce load on sewerage/effluent treatment plant during the periods of wet weather and optimize performance of the waste water treatment plant.

(iv) Sewage Treatment Plant (STPs) in Townships : STPs of different capacities are being installed at our stations which are at different stages of construction.

S.No.	NTPC Project / Stations	STP CAPACITY IN (MLD) MILLION LITRE PER DAY (1MLD=1000 m^3/day)
1	IGSTPP Jhajjar	1.150*
2	NPGC	1.700
3	BRBCL	1.200
4	Barh	1.700*
5	Lara	1.700
6	Kudgi	1.700
7	Bongaigaon	1.200*
8	Farakka	1.200
9	Meja	2.200*
10	Mouda	1.500
11	Khargone	0.500
12	Vallur	1.200*
13	Solapur	1.350*
14	Rihand	4.000
15	Tanda	1.500*
16	Gadarwara	1.200
	TOTAL	5.000

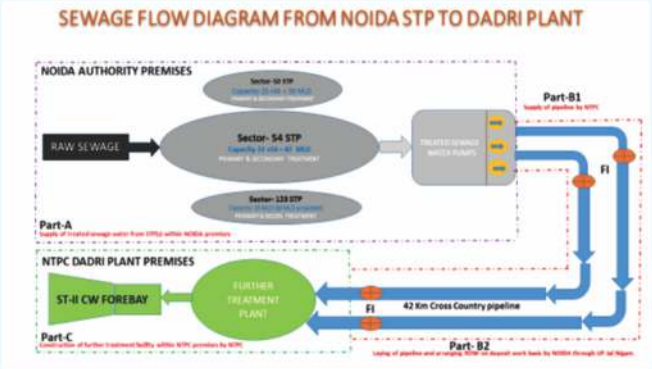
Capacities marked asterisk are under construction.

The domestic usage of water as per norms is 135 litre per person per day. For 3X800 MW plant, water requirement for the township is 1.7MLD. Out of this about 20% water is absorbed in the system. Balance 80% is treated and taken back into the system for reuse. Thus achieving 100% zero discharge. By this process, the domestic water saved by NTPC is approximately 25 million litre per day.

Use of Treated Sewage Water In Power Plants

By making use of treated sewage water from municipality wherever available near vicinity of power plants (within 50 kms), a great amount of fresh water can be saved. NTPC is currently making attempts in this noble endeavour for its plants like Dadri, Patratu, Solapur, Mouda and Meja etc.

In Solapur 52 MLD (52000 m3 /day) treated sewage will be used, whereas in Dadri 80 MLD (80000 m3/day). This will result in saving of equal amount of fresh water on earth surface leaving it for priority use like irrigation and drinking. Schemes for other projects are under finalisation.



Air Cooled Condenser (ACC)

Power plants use huge amount of water as circulating water for cooling of exhaust steam coming out from steam turbines in a closed cycle. However, a certain amount of water goes out of the system as evaporation loss. Air cooled condensers (ACC) technology substitutes the cooling medium for condensers totally from water to air. NTPC has already adopted ACC based super critical units in North Karanpura (3x660 MW) and Patratu (3x800 MW). Water requirement in a typical 3x800 MW ACC based project have drastically come down to approx. 1500 m3/hr compared to about 6500 m3/hr in a Water Cooled Condenser (WCC) based project of equivalent station capacity, thereby a saving of about 5000 m3/hr achieved.

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ENERGY EFFICIENCY

ENDEAVORS TOWARDS ENERGY EFFICIENCY

Coal and Gas are major raw materials for NTPC and are used as fuel for power generation. These fuels emits Green House Gases when burned inside the boiler for electricity generation. Hence, efficient use of these resources is a focus area for us. NTPC keeps on adopting several technological interventions in its O&M practices to increase the efficiency of the plants thereby reducing the fuel consumption per unit of electricity generated.

CenPEEP: A mission towards enhancing efficiency and protecting environment

Centre for Power Efficiency & Environmental Protection (CenPEEP) is an initiative of NTPC to mitigate greenhouse gas emissions from thermal power plants. CenPEEP is also assisting various state electricity utilities in India by demonstrating and adopting improved technologies and practices.

NTPC has initiated the 'Comprehensive Performance Optimization Programme' thereby successfully balancing the dual objectives of reducing carbon-di-oxide emissions that contribute to climate change and facilitating higher efficiency of power generation.

Through a special program called GEP, run through CenPEEP following milestones have been achieved.

1. Direct CO_2 emission reductions of 30 million tonnes in NTPC, and 63.7 million tonnes in SEBs (total 93.7 million tonne) are estimated.
2. Coal savings of about 23 million tonnes in NTPC, and 56 million tonnes in MSEB and UP are estimated.
3. The carbon abatement costs through GEP project in NTPC and SEB is about $0.43 per tonne. Comparatively, average cost of carbon reduction through CDM in 2010 was $14 per ton.

EEMS (Energy & Efficiency Management System)

Implementation of EEMS system comprising periodic performance testing, analysis and formulation of action plans has been implemented across the company. All off line tests instruments and equipments have been procured at stations and being used for performance tests. New stations have been provided with list of test instruments & technical specification for procurement.

ENERGY CONSERVATION LEADING TO REDUCTION IN AUXILIARY POWER CONSUMPTION

Some of the important energy conversation measures taken by NTPC are as under:

Energy Audits

During FY 18, all stations had conducted Auxiliary Power Consumption Energy Audits. Out of these, nine stations conducted mandatory energy audit as per statutory requirement under Energy Conservation Act-2001.

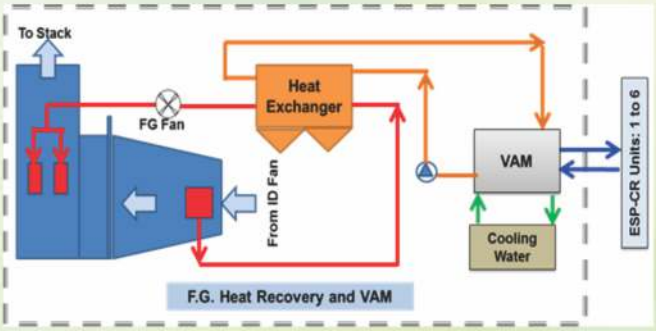
Milestones Achieved

- Retrofitting HT VFD in ID Fans of one unit each at Talcher Kaniha & Dadri.
- Replacement of old and inefficient BFP cartridges based on high SEC.
- Single stream running of BFP, ID and FD fans at prolonged partial load operation.
- Energy Efficient Coating on pump internals of Cooling Water / other large water pumps
- Installation of VFD's in various LT drives
- Installing grid-connected roof top Solar PV systems
- Retrofitting FRP blades in CT fans
- Replacing existing motors with Energy Efficient motors
- De-staging of excess capacity HPBFP to optimize power consumption
- Replacing old compressors with energy efficient screw compressors
- ESP hopper heater modification to save energy
- BFP Power saving by adopting sliding pressure operation during part loading
- Optimization of operation of CW pumps, ARCW, clarified water pumps and cooling tower fans during part load operation and low ambient temperature conditions
- Practicing merit order operation of drives through online monitoring of power consumption.
- Optimizing no of running mills through timely maintenance of mills based upon SEC of mills.
- Using TDBFP during unit start ups
- Replacement of existing lighting (FTL's, HPSV's) in boiler, turbine, switchgear rooms, offices with LED lighting and replacement of street lighting HPSV / Halogen / FTL fixtures with LED light fixtures in plant and township.

Other R&D efforts to reduce Auxiliary Power Consumption

NETRA (NTPC Energy Technology Research Alliance), the R&D wing of NTPC Ltd. has taken many exemplary initiatives in areas of energy saving through process innovations.

400 TR Flue Gas Waste Heat AC System at Talcher

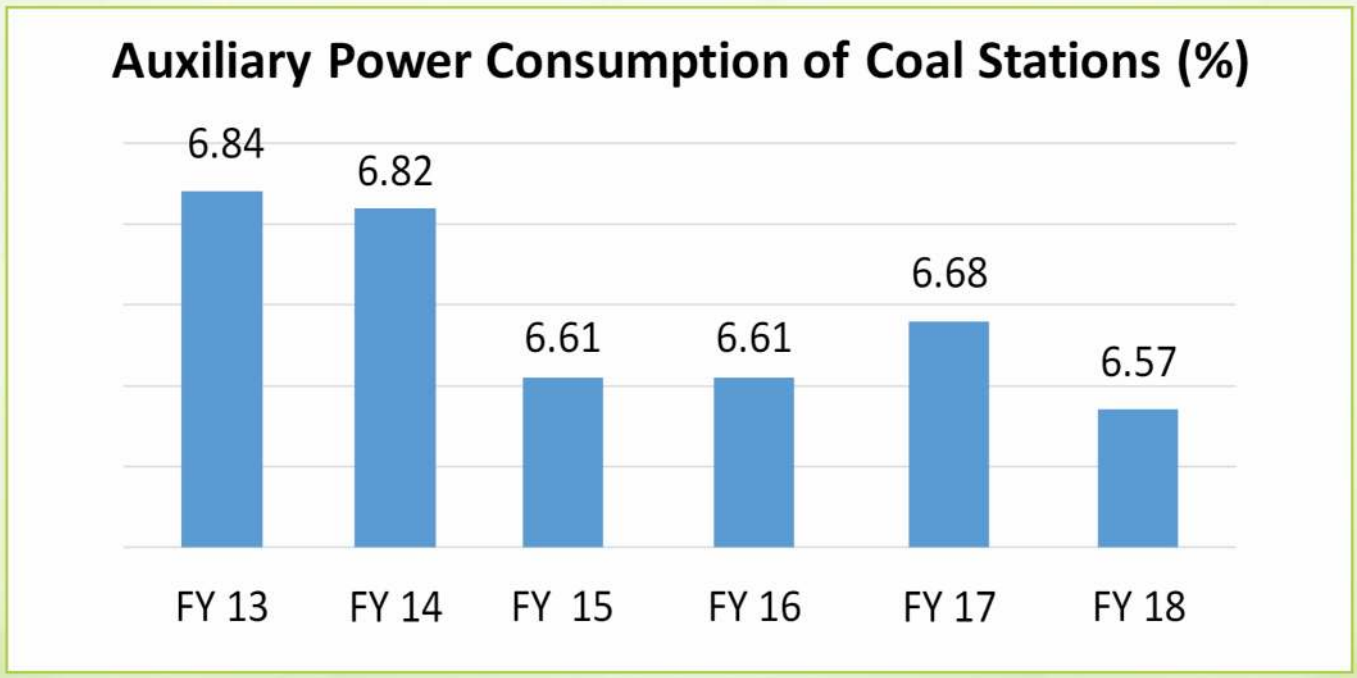


At Talcher Kaniha station of NTPC, a 400 TR Air Conditioning system has been installed to to cater Stage I & II ESP & VFD Control Rooms. The system does air conditioning using waste heat of flue gas instead of electricity or steam. Because of this, there has been reduction in Auxiliary Power of 2.6 MU / year. It is Green House Gas (CFC & HCFC) free thermally driven VAM based System and responsible for reducing 2100 Tonnes of CO_2 per year.

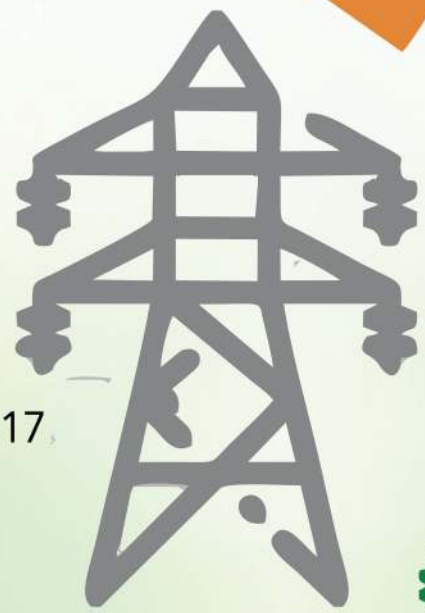
Reduction in ID Fan Power/Flue Gas Duct Erosion

NETRA has been working on modification and optimization of the design of ducts for reduction in ID Fan Power/Flue Gas Duct Erosion. It has completed these modifications in the following stations:

- Kahalgaon St-I (4*210 MW): ID Fan Power reduced by 120 kW per Unit
- Simhadri St-I (2*500 MW): Modification and O/H resulted in reduction of ID fan/unit by 730 kW
- Vindhyachal St-I (4*210 MW): ID Fan Power reduced by 70 kW per Unit
- Singrauli St-I (2*210 MW): Overall reduction of 30mmWC on account of extensive duct work and CFD based modification, CFD modelling work related saving 90 kW per unit
- Tanda (4*110 MW): ID Fan Power reduced by 100 kW per Unit



REDUCTION IN AUXILIARY POWER CONSUMPTION



APC* (%) in FY 2017
6.68%

APC* (%) in FY 2018
6.57%

*Coal Power Stations

Supporting India's INDC objective of reducing emission intensity of its GDP by 33 to 35%

Advanced Ultra Supercritical Technology

Aiming for Quantum Leap in Thermal Efficiency

A program to develop Advanced Ultra supercritical (AUSC) technology is underway by a consortium of NTPC, BHEL and IGCAR. The AUSC Project envisages development of indigenous technology for steam parameters of 310 Kg/Cm^2 and 710°C/720°C temperature. Such parameters are way higher than steam parameters used in contemporary plants globally and would result in top of line efficiency of 46%. This is sharp increase from the contemporary efficiency levels of 38% (sub-critical units) and 42% (Telangana, an ultra super-critical unit). It will result in reduction of CO_2 emissions to the tune of 20% compared to a traditional sub-critical plant. The project is a leap for an industry which thus far has exhibited technology dependence wherein major equipment such as steam turbine and boiler were all obtained through international technology collaborations.

After development of the AUSC technology, we propose to establish an 800MW Adv-USC Demo plant based on indigenous technology. If successful, this will prove to be a major national achievement in the direction of self-reliance in getting an efficient, cleaner and affordable power generation technology.

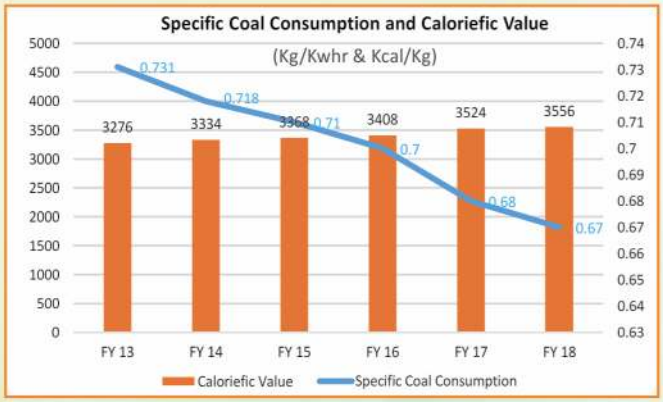
RESOURCE/MATERIAL EFFICIENCY

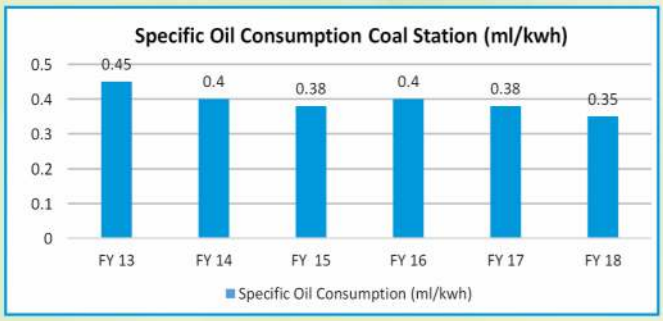
REDUCTION IN SPECIFIC CONSUMPTION OF COAL AND OIL

NTPC follows a comprehensive approach for improving resource efficiency with due focus on the regular evaluation of resource consumption intensity. There has been emphasis on its further improvement through measurement, monitoring and implementation of conservation plans.

Several steps for improvement in cycle efficiency and reduction of losses have been taken resulting in significant improvement in saving of fuel (Coal and Oil) per unit of energy generated.

The trends for improvement in performance parameters of specific coal consumption and specific oil consumption are shown in graph below:





As far as coal is concerned, adoption of higher size units for power generation is leading to efficiency improvement which in turn is reducing the specific coal consumption.

Using Agro residue as an alternative Fuel in Conventional Coal Fired Boilers

NTPC is all set to start a first biomass co-firing project in India at Dadri on commercial scale from September 2018. NTPC has already placed orders to procure a total of 240 MT of agro residue based pellets based on torrefied and non torrefied technology. Co-firing is more economical and efficient than dedicated biomass plant and also avoids risk of loss of generation due to alternate fuel availability. Co-firing would not only discourage infield crop burning abating pollution, but also reduce consumption of coal and oil significantly.

Optimisation of Land Use

NTPC, being a growing organization, is focusing on expansion of its existing projects (Talcher Thermal, Singrauli STPP, Ramagundam STPP, Patratu STPP) rather than going for a green field project. Land available with existing project will be used for proposed expansion project thereby reducing NTPC's land footprint.

- Construction of multistory buildings and staff quarters to reduce land requirement in townships (Lara, Darlipalli, Patratu etc.).
- Ash utilization is being increased to reduce land requirement for ash disposal.
- Waste to Energy plants at Varanasi and Badarpur for municipal solid waste will save several acres of land for land fills.

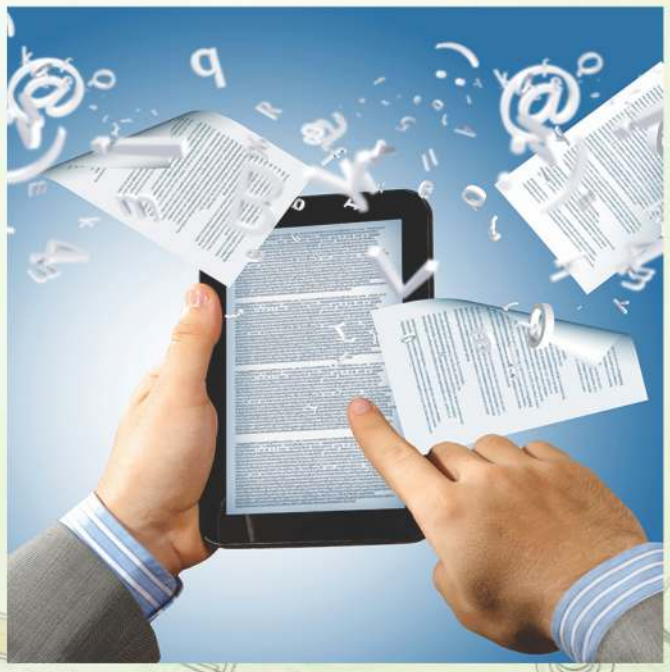
SAVING PAPER, SAVING THE ENVIRONMENT

In line with the "Digital India" initiative NTPC steps towards digitization by implementation of companywide paperless office through "PRADIP" to save on expensive office space, paper use and protection of Environment. It will cover more than 270 business processes, which shall become paperless.

About 3.3 crores of A4 size papers equivalent to 3,984 (approx.) fully grown trees would be saved annually through paperless office initiative.

NTPC is encouraging work environment in which the use of paper is eliminated or reduced by converting documents into digital form. "Going paperless" can save money, boost productivity, save space, make documentation and information sharing easier more secure, and help save the environment.

- The following IT systems / automation have been implemented wherein paper usage is NIL
  - Reimbursement, Travel Claim, Ticketing
  - Business Dashboards to avoid printout of information providing all essential details online
  - MIS Reports in SAP-Business Intelligence, with a facility for drill down, avoids use of paper completely.
  - Intranet Portal wherein all Notices / Circulars are made available on-line.
- NTPC "Samwaad" App for sharing stories & communication in digital form.
- NTPC "Sampark" App eliminated use of printed telephone directory.



PAPERLESS OFFICE

RENEWABLES

TAKING MAJOR LEAP TOWARDS RENEWABLES

Renewable energy technologies provide clean and green sources of electricity. NTPC is taking various steps to makes its energy portfolio greener by adding significant capacities of renewable sources. By 2032, we plan to have 32000 MW capacity through renewable sources constituting nearly 25 % of our total power capacity. NTPC has also added significant capacities of small scale hydro-power plants.

NTPC has already commissioned 870 MW Solar PV Projects and 50 MW Wind Power Project and consistently adding further capacities.



Renewable Energy Projects

SOLAR ENERGY:

1.	**Dadri**	Uttar Pradesh	5
2.	**Port Blair**	Andaman & Nicobar Island	5
3.	**Ramagundam**	Telangana	10
4.	**Talcher Kaniha**	Odisha	10
5.	**Faridabad**	Haryana	5
6.	**Unchahar**	Uttar Pradesh	10
7.	**Rajgarh**	Madhya Pradesh	50
8.	**Singrauli**	Uttar Pradesh	15
9.	**Ananthapuram**	Andhra Pradesh	250
10.	**Bhadla**	Rajasthan	250
11.	**Mandsaur**	Madhya Pradesh	260
		Total	**870**

WIND ENERGY:

1.	**Rojmal**	Gujarat	50
		Total	50

HYDRO ENERGY:

1.	**Koldam**	Himachal Pradesh	800
2.	**Singrauli** (Small Hydro)	Uttar Pradesh	8
		Total	808

Cumulative Solar Generation Capacity

VENTURING INTO E-MOBILITY

NTPC has entered into E-mobility business, starting with electric vehicle charging infrastructure. It has already started two electric vehicle charging stations on pilot basis in its office premises at New Delhi and Noida. Further, the company is in process of developing e-vehicles charging infrastructure and procurement of Electric buses for Jabalpur. Going forward, the company envisages to build an e-mobility ecosystem.

Supporting India's INDC objective of producing 40 per cent of electricity from non-fossil fuel based energy resources by 2030

WASTE MANAGEMENT

Waste, currently viewed as a menace, can also be a resource. NTPC is taking initiatives for implementing the "Waste to Wealth" concept through Reduce, Reuse and Recycle approach for all the waste generated from its operations. Our efforts have three-fold objective of:

- **Reduction of waste and its impact on the environment**
- **Capacity building through raising awareness**
- **Social Inclusiveness through creation of income opportunities and employment**

Our primary waste, which is basically a by-product of thermal power generation, is ash. Other major waste generated by us is e-waste due to fast obsolescence of IT hardware. Solid wastes are also generated in our township and office premises.

Ash Management

Sustainable ash utilization is one of the key concerns of NTPC and the Company strives to maximize it. NTPC has introduced Ash Policy 2015, which is a vision document dealing with the ash utilization issue in an integral way from generation to end of life. This policy aims at maximizing utilization of ash for productive usage along with fulfilling social and environmental obligations, as a green initiative in protecting the nature and giving a better and clean environment to future generations.

During FY-2017-18, 60.35 million tonnes of ash was generated and 53.45% i.e. 32.24 million tonnes of ash had been gainfully utilized in various areas such as in cement/concrete industries, bricks/ blocks making, road embankment construction, ash dyke raising, mine filling, land development works etc. Seven NTPC stations (Badarpur, Dadri, Tanda Unchahar, Simhadri, Ramagundam and Talcher-Thermal) have achieved more than 100% Ash utilization.

Innovative Measures for Ash Utilisation by NETRA (NTPC Energy Technology Research Alliance)

Use of Bottom Ash as Replacement of Fine Aggregate (Sand) in Cement Concrete

A road patch (M15) has been constructed at NETRA using 50% bottom ash in place of sand in the cement concrete mixture. It has been estimated that maximum strength of M25 could be attained through this technology. Constituents were coarse aggregate (20 mm and 10 mm), fine aggregate, bottom ash and cement.

Sintered fly ash Light Weight Coarse Aggregates manufacturing plant for technology demonstration at NTPC Sipat

Structural concrete of grade up to M35 can be easily obtained using sintered lightweight aggregate as coarse aggregate.

.NETRA is setting up Light weight aggregate plant with capacity of 50000 Cubic mtrs/annum at NTPC-SIPAT at the project cost of Rs.39 cr. E&C under progress. Large scale manufacturing plants can be setup at NTPC stations.

Approach Road using Bottom Ash as a replacement of sand in concrete at NETRA

Construction of Fly ash based Geo-Polymer concrete road as per IRC specifications:

Fly ash based Geo-polymer concrete road has been constructed successfully at Dadri station as per IRC specifications first time in the country. The performance highlights of this Geo-polymer concrete road are:

- Fly ash based green concrete road without cement with M 40 strength
- Construction of fly ashbased GPC road without water curing
- Negligible CO2 emission in comparison to high CO2 emission in cement production
- High early compressive strength is achieved within 7 days in comparison to 28 days for normal Concrete road
- Negligible Shrinkage
- Monolithic and low thermal conductivity
- Good durability in aggressive environment compared to conventional concrete road

E-Waste Disposal

The rapid advances in technology have resulted in obsolescence of IT and C&I hardware at a very fast rate. Handling and disposal of the E-waste is being done effectively by NTPC to protect the environment. The details of the E-waste management and disposal mechanism being followed are given below:

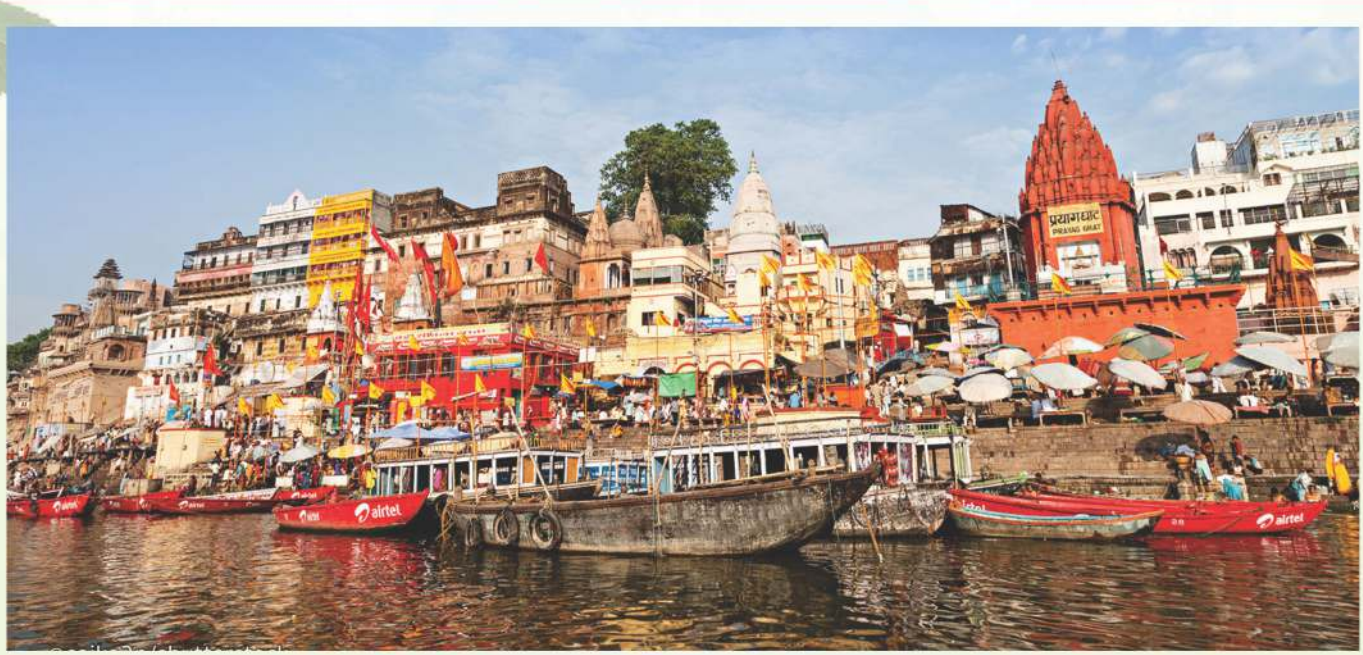
- In 2015, NTPC formulated an e-waste management, handling and disposal policy. The periodicity of identification and initiation of disposal action is prescribed as every six months in the policy so that the E-waste is not piled up.
- For PCs and peripherals (i.e IT assets) there is a buy back policy in place as per which employee can opt to buy back the old IT asset on completion of its defined useful life period of three years .
- For all other e-waste, a scrap and surplus identification and disposal committee (SSIDC) is constituted to facilitate quick disposal.
- E-waste is also e-auctioned to authorized collection centers or registered dismantlers or recyclers
- In few cases the old hardware (e-waste) which needs to be replaced, is returned to the producers / suppliers / OEMs through buyback as per purchase orders.
- E-waste (Management) rules 2015 are adhered to by the organization.

Recently, an organization wide drive under the leadership of top management has also been undertaken for disposal of the E-waste and almost all the sites have successfully disposed off the accumulated E-waste.

E-WASTE DISPOSAL STATUS (Excluding Pcs buyback by employees)

S/N	Description	Qty gen	Utilisation (%)
1	Total E-waste in Nos (PCs, Printers, UPS, Batteries, Fax Machines, Tel Instruments, misc IT Hardware like Modems, CD/DVD Drives, PCBs, Display Units etc.)	11338	100
2	Total E-Waste in MT	787.46	100

NTPC'S FORAY INTO SOLID WASTE MANAGEMENT



Like many of its other initiatives which is aligned to nation building, NTPC has forayed in the field of solid waste management along with diversification of its energy portfolio into waste to energy. Under the Swachh Bharat Mission, Govt. of India is emphasizing the scientific management of Municipal Solid Waste (MSW) through establishment of 'Waste to Energy' (WtE) plants across India. In order to leverage Government's efforts in this sector, NTPC initiated the process to identify companies to partner with NTPC for setting up of 100 number of WtE plants all across India and received an encouraging response from both domestic and International players.

CHANGING THE LANDSCAPE OF HOLY CITY VARANASI

NTPC has successfully revamped the "Waste to Compost" plant at Kadsada, Varanasi and managing Operation & Maintenance (O&M) of this 600 Tons per Day (TPD) capacity plant. The plant generates about 60-80 TPD of compost. Sanitary land fill facility and Leachate treatment facility have also been created at Varanasi to ensure scientific disposal of waste.

Also, NTPC has recently awarded 24 TPD thermal gasification based demo scale Waste to Energy plant at Varanasi. The Municipal Solid Waste (MSW) is first converted to producer gas, which is then used to generate approximately 200 kW of electric power. This project is scheduled to commissioned by October 2018.

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BIODIVERSITY

AFFORESTATION

NTPC has undertaken a lot of tree plantation drives covering vast areas of land in and around its projects. Till date about 32 million trees have been planted throughout the country including 10 million trees planted during 2016-17 under accelerated afforestation programme. The afforestation has not only contributed to the creation of additional carbon sinks thereby protecting the ecology and environment but also helped in improving the 'aesthetics' of surroundings.

Supporting India's INDC objective of creating an additional carbon sink of 2.5 to 3 billion tonnes of carbon dioxide equivalent by 2030 through additional forest and tree cover

NTPC planted approx 1 crore trees during 2016-17 to mitigate the GHG emissions

WILDLIFE CONSERVATION

Wildlife plays an important role in balancing the ecosystem and providing stability to different natural processes of nature. NTPC is complying to all strict criterias of MOEF & CC for establishing new power plants while maintaining adequate distance from eco-sensitive areas like National Parks, Wild life Sanctuaries, Biospheres Reserves are maintained. There are some Wildlife Sanctuaries/Wildlife habitats nearby our business units. To minimize the ecological impact of operations of NTPC and to conserve endangered, rare and threatened species in these areas, NTPC has invested in studies of wild life conservation. It has also supported the State forest departments, NGOs, scientific and academic institutes for implementation of Wild Life Conservation Plan to protect wild life nearby our units.

The following Wild life Conservation initiatives have been taken by NTPC.

Conservation of Great Indian Bustard near Solapur STPP.

The Great Indian Bustard (GIB) is a large, handsome bird of the short grass plains of the Indian subcontinent. GIB is included in Schedule I of the Indian Wildlife (Protection) Act 1972. GIB has become extinct in 90% of its former range and is now confined to some parts of Rajasthan, Maharashtra, Gujarat, and Andhra Pradesh. The conservation plan includes seasonal biodiversity survey of GIB, survey of predators like wolf etc., village community awareness campaign, impact of pesticides, bustards friendly agriculture practices and mitigation measures for power line collusion of GIB and other large birds etc.

Great Indian Bustard

Conservation of Marsh Lands and Birds visiting Samaspur Bird Sanctuary and Neighbouring Areas Unchahar

FGUTPP is located at a distance of about 8 km. from Samaspur Bird Sanctuary. A total of 113 bird species are found in the area. The most abundant bird species in the area are rose ring parakeet, rock pigeon, oriental turtle dove, laughing dove, spotted dove, yellow wattled lapwing, black kite and Jungle babbler. Bird species, those were earlier commonly occurring in the area, are grey francolin, Indian peafowl, Indian grey hornbill, Asian palm swift, Egyptian vulture etc. The commonly occurring waterfowl species are whistling teals, common teal, Eurasian wigeon, Gargeney and common pochard. Species such as spot-billed duck, red crested pochard and tufted duck were low in occurrence and were categorized as rare species. The different interventions in conservation plan are, Public Education and Awareness Promotion, Survey and Monitoring, Anti-Poaching Measures, Afforestation, Regeneration of Marshes, Grassland and Lakes, Cleaning of Lakes and Removal of Weeds etc.

SARUS CRANE
(IUCN Status: Vulnerable)

ORIENTAL DARTER
(IUCN Status: Near Threatened

PAINTED STORK
(IUCN Status: Near Threatened)

BLACK IBIS
(IUCN Status: Near Threatened)

Conservation of wildlife near by Dulanga Coal Mine Block

The site specific wildlife conservation plan has been prepared for the Dulanga Coal Block and its immediate surroundings (15 km radius) in Sundargarh district of Odisha. Coalfields lying in the south-eastern extremity of NW-SE trending master basin belt of Son-Mahanadi Valley. The forests of the area mainly fall within the sub group Dry Mixed Deciduous type and Dry Peninsular Sal Forests .

Sloth Bear

Python

Python, Sloth Bear and Common Indian Monitor are the only species of wild animals, which are part of Schedule-I of the Wildlife (Protection) Act, 1972 found within 15 km area.

Common Indian Monitor

The main objectives of Conservation plan are Habitat restoration, rehabilitation of the barren and degraded forest areas, restriction on illegal felling of trees, minimization of the impact of mining project, planting of grasses and trees favourable to wildlife, anti-poaching measures etc. Different Measures have been taken to minimise Man-Animal conflict during rail /road transportation of coal. Various conservation measures under the wild life conservation plan like , fencing around the mining lease area to ensure that the wandering fauna do not enter the mine and get themselves harmed in the process and etc.

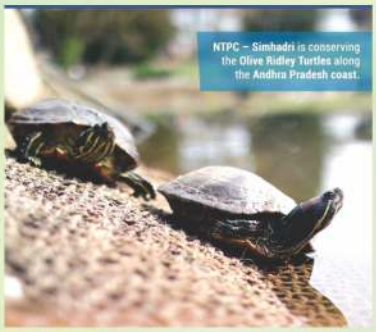
Conservation of wildlife nearby Talaipalli Coal Block and MGR

Basic objectives of this conservation plan is to maintain an ecosystem as natural as possible and minimize the impact of mining activities and MGR on wildlife habitat. The following interventions are proposed in conservation plan.

1. **Fencing of Mining area**
2. **Construction of watch towers and depute watch & ward**
3. **Creation of water holes, salt licks, hideouts**
4. **Soil & water conservation**
5. **Creation of awareness, wildlife camp & training etc.**

Saving the Turtle and Creating Coral Reef

The Andhra Pradesh coast is not known for natural coral reefs, but the Simhadri unit and the Central Marine Fisheries Research Institute (CMFRI) have joined hands to deploy artificial reefs near the coast. These reefs simulate coral beds, and function as a comfortable habitat for fish and diverse marine organisms. The first deployment of artificial reefs in Andhra Pradesh was done off the Muthalampalem coast, and the early signs have been encouraging, with fishermen



reporting in increase in their catch. CMFRI scientists believe that once the reefs mature, the gains will be better visible.

Development of Eco-Parks

Eco-parks are best example of manmade habitation for conservation of ecology. Dadri eco-park developed on ash mound is a unique experiment of conservation of biodiversity through management of waste. The said eco-park at Dadri plant is home for various animals, birds, reptiles, developed by NTPC. Various birds like endangered Lesser Florican, Kingfisher, Sarus Crane, Moorthen, Hoopoe, Common sandpiper, Drongo, Sopt Billed duck etc. are found in this park.

Black Buck Conservation Plan at Meja STPP

India's first conservation reserve for black buck is located at Allahabad's Meja forest division. NTPC joint venture project Meja STPP is supporting the Forest department for implementation of Black Buck conservation plan.






EMISSION CONTROL

Ambient Air Quality and Emission Monitoring

All NTPC power stations are equipped with continuous ambient air quality monitoring stations (AAQMS) to capture the real time data of PM 10, PM 2.5, SOX, NOx and access has been provided to regulators such as Central Pollution Control Board and State Pollution Control Boards. Additional ozone analyzers for ambient air are also being provided phase-wise at the existing stations. Continuous Emission Monitoring System (CEMS) have been installed recently in various operating stations.

Phasing out of Ozone Depleting Substances (ODS)

NTPC is in the process of phasing out the ozone-depleting substances (ODS) by reducing consumption of its use.

Control of Fugitive Emissions in plant

Automatic dust suppression and dust extraction system are active at coal handling plant and ash handling plant to prevent fugitive emissions.

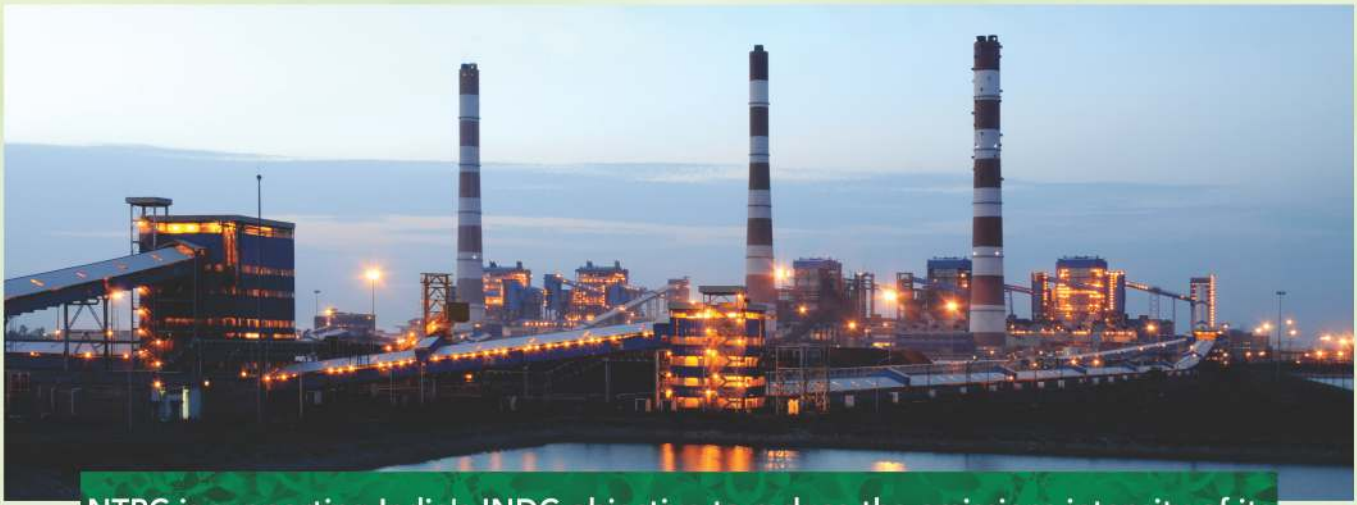
At Ramagundam STPP, transportation of ash by rail in covered wagons has been started to prevent fugitive emissions during road transportation of ash.

Beshram plantation (ipomia) has been done on the ash dykes which are temporarily abandoned, for controlling fugitive dust.

HCSD system have reduced the problems of fugitive emissions from Ash pond.

Compliance to Revised Emission Norms

I. NTPC is constantly coming up with new designs its upcoming plants to comply with new norms. Parallelly, various activities are being taken up for operating units and under construction units for meeting revised norms. The Company is working to install additional air and water pollution



NTPC is supporting India's INDC objective to reduce the emissions intensity of its GDP by 33-35% by 2030 from 2005 level.

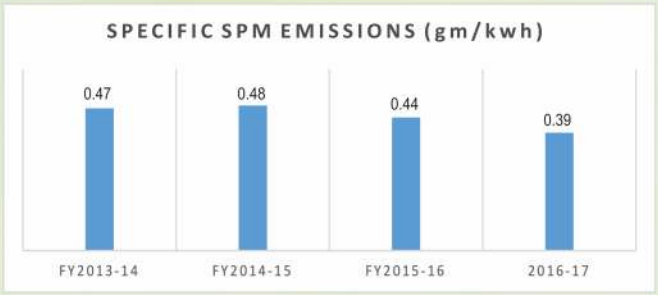
control systems at various projects to comply with the applicable new environmental norms dated December 7, 2015.

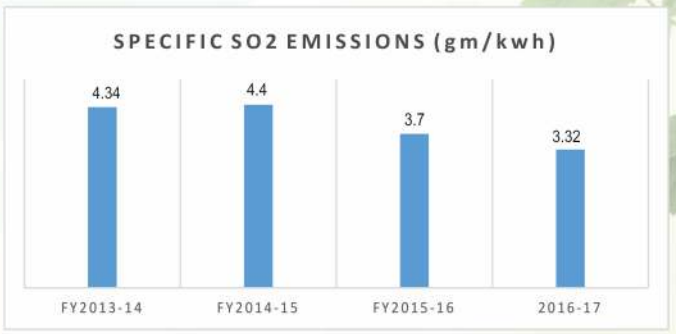
II. CEMS for monitoring of SOx and NOx in all units on real time basis are being installed and commissioned in addition to the opacity meter installed for monitoring of particulate emission. Installation of real time monitors for pollutants in effluents (EQMS) has also been completed for all its existing projects.

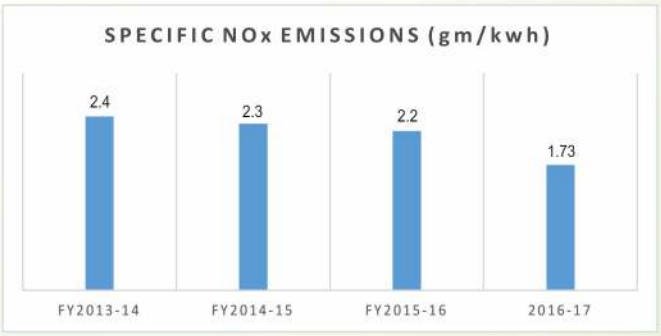
III. We have recently introduced analysers for Mercury monitoring for both AAQMS and CEMS.

IV. We have already undertaken extensive R&M activities of ESPs for complying to emission limits of particulate matter. High efficiency Electro-static Precipitators (ESPs) with efficiency of the order of 99.97% with advanced control systems have been provided in all coal based stations to keep Particulate Matter (PM) below the prevailing permissible limits. All upcoming new plants are being provided with ESPs designed in such a manner that would cater to the notified future stringent norms.

Trends of SO_2, SPM and NOx emission are as below.







V. NTPC has already completed tendering of installation of Flue Gas De-Sulphurisation System at 11 projects and stations of total 17,440 MW capacity in order to meet SO_2 emission limits as per new environmental norms. First FGD has been commissioned at Vindhyachal stage-V.

VII. Selective catalytic reduction (SCR) will be required for controlling of NOx for which pilot test studies are being undertaken at various NTPC operating stations to check technological suitability.

VIII. Water audits are regularly performed to optimize its use.

OTHER NEW INITIATIVES FOR POLLUTION CONTROL

Hybrid Solar Thermal Plant

The Company has awarded a project for Solar Thermal Integration with the existing coal based unit at Dadri during the financial year 2016-17. The project is under construction and is expected to be commissioned this year. The expected peak electrical output contribution from the plant would be about 3.6 MW.

This shall result in coal savings of around 3,825 Tonnes/year and in CO_2 emissions reduction of around 4,060 Tonnes/year.

Carbon Capture and Utilisation (CCU) activities at NETRA - Modified amine absorption based process to separate CO_2 from flue gas

A pilot test facility on new CO_2 absorption technology has been set up by NTPC NETRA for carrying out energy studies on different amines. The experiment is targeted to identify a modified amine which will have 20-25% less energy in stripper column as compared to Monoethanolamine (MEA) process. A Synthetic flue gas of N2 and CO_2 mixture is used for experimentation.

It is Indigenously developed technology in collaboration with IIT Guwahati and can be scaled up to 20 lpm flow gas capacity test facility. Energy penalty is expected to reduce to 3.0 MJ/Kg of CO_2 which is 30% less as that of conventional MEA.

Microalgae based process for utilization of CO_2 in flue gas and conversion into Biomethane

It is a biological route, in which CO_2 from flue gas is fixed through Micro algae cultivation. The algae, thus grown can further be utilized for the production of useful products.

In collaboration with IOCL, NETRA had established a pilot plant for 'Microalgae based process for utilization of CO2 in flue gases' at NTPC–Faridabad and successfully demonstrated the CO_2 fixation through algae.

The conversion of Micro Algae into Bio fuel was found to be techno-economically non-viable. The possibility of Algae conversion into Bio methane along with horticulture and kitchen wastes of NTPC-Faridabad is under consideration.

Benefits include Demonstration of capture and utilisation of flue gas CO2, Utilisation of organic wastes of NTPC-Faridabad viz., kitchen waste and horticulture waste, Efficient and full utilisation of the half load running existing bio methanation plant of NTPC-Faridabadn house generation of kitchen fuel, viz., Biomethane from the waste products of NTPC-Faridabad.

ACKNOWLEDGMENT

We are indebted to various functional groups of NTPC in different areas that are working in tandem to contribute to our shared commitment to environment stewardship.


SAVE
THE WORLD

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BEAT PLASTIC POLLUTION

'If you can't reuse it, refuse it'

India has been chosen as the global host of the World Environment Day, observed on 5th June, 2018, that will focus on greater action against single-use plastic pollution, in association with the United Nations Environment Programme (UNEP). Approximately 25,000 Tonnes plastic is generated annually in India.

NTPC is committed to prevent Plastic Pollution at its units, townships, offices etc.

Do's

- Use cloth/Jute bag in place of Plastic bag during purchasing vegetables/groceries.
- Recycle grocery bags – return to retailer
- Serve water in glass/other reusable hygienic containers and avoid use of bottled water in meeting and functions.
- Use metallic lunch box in place of plastic lunch box.
- From shop keepers, insist on Biodegradable bags.
- Stuff multiple plastic bags into one while disposing to prevent them from flying away and causing litter or clogging
- Reuse the plastic bags for collecting the garbage and dog poop.
- Collect empty plastic bottles, canes, boxes and sell to recyclers.
- Use metallic dustbin in place of plastic dustbin, wherever feasible.
- Only take a plastic bag when you really need it
- Raise awareness about plastic pollution

Don'ts

- Retailers or Shop keepers sell or provide commodities to consumer in polythene carry bags or plastic sheet or multilayered packaging. Don't accept such bags.
- Litter plastic bottles and polythene bags on streets.
- Use plastic in wrapping of invitation cards, gift wrapping etc. (use colored ribbons instead)
- Throw food items in polythene bags, it may be eaten by cattle and injure them

WORLD ENVIRONMENT DAY

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