एनटीपीसी
NTPC
A Maharatna Company

Save Water Save Lives

NTPC Practices & Initiatives in Water Conservation

Published by NTPC Power Management Institute (PMI)
on the occasion of World Water Day - March 22, 2018

PREFACE

WATER - A Precious Resource

Scarcity of water is becoming a critical problem all over the world. In a comprehensive report published by International Finance Corporation (IFC) and McKinsey titled "Charting our water future- 2030" it is estimated that global water withdrawals including agriculture, industry and domestic would increase from current levels of about 4,500 billion m^3 to 6,900 billion m^3 by 2030. This demand will be 40 percent above the current accessible water supply. Of this, agriculture accounts for approximately 3,100 billion m^3, or 71 percent of global water withdrawals currently, which itself will increase to 4,500 billion m^3 by 2030. Centres of agricultural demand will primarily emerge from India, Sub-Saharan Africa and China. Drinking and house-hold demand will also increase substantially due to increasing population and urbanisation particularly in country like India. The report of IFC and McKinsey predicts that the one-third of the population, concentrated in

developing countries, will live with deficit larger than 50 percent.

India currently has about 17 percent of the world's population, 2.5 percent of the land mass and 4 percent of the world's water resources. These limited water resources are depleting rapidly while the demands on them are increasing. Drinking water supplies in many parts of India are either non-existent or intermittent. By 2030, demand for water in India will grow to almost 1500 billion m3. Against this demand, India's current water supply is approximately 740 billion m3. As a result, India would face severe deficit unless concretive action is taken fast.

NTPC, as a responsible corporate citizen, has pro-actively committed itself to conservation and rejuvenation of water and has been taking several steps in this direction. It has taken on to itself the role of water steward as a corporate.

NTPC issued its Water Policy in 2017 which forms the opening section of this compendium. Various water conservation measures have been taken up by the company to reduce water consumption in power generation by using 3Rs (Reduce, Recycle & Reuse) as guiding principle. Fresh water is being drawn by NTPC stations from various water bodies such as rivers, reservoirs, canal etc. Water is withdrawn as per contractual agreements with state authorities. NTPC takes care not to withdraw water from water bodies which are recognized as environmentally sensitive due to their relative size and location or to protect any endangered species. This compendium shows some of the steps taken by NTPC in the direction of water conservation and rejuvenation.

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Don't let life slip
down the drain

MESSAGE

Message

Water is the lifeline for all living beings on planet earth and this makes access to water a fundamental right of all who live in this world. Echoing this sentiment, water has been recognized as one of the most important components of United Nations Sustainability Development Goals (SDGs) as well as in India's Intended Nationally Determined Contributions (INDCs) towards climate change.

NTPC is fully committed to water conservation. Though power generation is a water intensive industry, we are making conscious efforts to lower our water footprint in all activities, minimize fresh water usage in our plants and making our processes water efficient. We are not only tweaking our existing installations but we are also deploying advanced technology solutions like Air Cooled Condensers and desalination plants to save every drop of water.

It is with immense pleasure and a deep sense of satisfaction that we are publishing this compilation of NTPC's water initiatives and best practices to highlight our commitment to water sustainability. I am sure this will serve as an inspiration to everyone in the power sector to do their part to conserve water.

We will continue to strive for judicious use of water in all our business activities and daily lifestyle to achieve a water efficient, clean and green future.

With best wishes,

(Gurdeep Singh)
Chairman & Managing Director

Piped water supply provided by NTPC Simhadri in nearby villages

NTPC WATER POLICY

Water Policy-2017

I. Purpose :

Water is the basic amenity for domestic, agricultural and industrial use. As a responsible corporate citizen, NTPC commits to be a flag-bearer, and optimize its processes & practices to increase fresh water availability for other uses.

At the same time, the quality of water/steam is a no-compromise zone for NTPC's process to ensure uninterrupted supply of power and long life of its equipment.

NTPC hereby commits to pro-actively address water sustainability issues by implementing this Water Policy, which will serve as a directive for establishing water management strategies, systems, processes, practices and research initiatives keeping in view sustainability aspect, to: (1) comply with legal requirements, (2) minimize its water footprint, and (3) maintain desired water quality during processes and discharges, if any.

II. Philosophy :

NTPC shall follow 3 R's for water conservation and management while carrying out its core business activity of Power Generation.

III. Applicability :

This policy shall apply to all establishments of NTPC, and each employee shall be made a partner in implementing the policy.

IV. Objective :

1. To be amongst the least water intensive power generator globally.
2. To ensure right quality of water at every point every time, all the time.

V. Policy:

NTPC shall achieve these objectives by:

1. Stakeholder Management:

NTPC shall:

a. Identify internal and external stakeholders (such as employees, Opinion makers, media, community, District administration, and respective State Governments etc), and list their water-related expectations.

b. Prioritize and identify the areas which need action based on (a), and establish phase wise goals and targets.

c. Take required technological support that promote water sustainability, by collaborating with:

   1. International and national research institutes.
   2. Equipment manufacturers and suppliers.
   3. Peer group/internal expertise.

d. Play key role for undertaking study and policy advocacy for water related issues.

e. Communicate key "water messages" to all the stakeholders to promote awareness on water sustainability issues and enforce timely and informed decisions.

2. Water Stewardship:

NTPC commits to:

a. Become a Zero Liquid Discharge company for all closed cycle operating stations.

b. Identify and implement Water Management initiatives to reduce specific water consumption in NTPC premises.

c. Cascade water quality at all points of use, from best to worst quality of water required.

d. Establish water footprint of NTPC business across its entire value chain, and strive to reduce it, through Stakeholder Management.

e. Ensure right quality of water (or steam) at every point of use, with zero deviation.

f. Break down water consumption for all processes individually and benchmark the same internally with other plants and outside NTPC.

g. Regularly review the quality and availability of water – from traditional and non-traditional resources – to ensure that NTPC's water supply requirements are met in the short, medium and long term.

h. Form focused Working Groups at Corporate, Regional and Sites responsible for entire water systems.

i. Invest in research and adopt new technologies aimed at improving water efficiency and minimizing impact on water resources.

j. Measure and track domestic water consumption vis-à-vis global standards, for optimization. Adoption of latest technologies to achieve the desired results shall be encouraged and promoted.

k. Ensure that potential of rain water harvesting is fully garnered at all locations, in plant and township locations as well as green belt areas.

l. Rehabilitate all the water bodies located in establishment/project affected areas/villages in phased and time bound manner and re-visit them for further activities in a cycle of 5/6 years.

3. Compliance and Assurance:

NTPC shall continue to:

a. Ensure that Stations have, and comply with water-related regulations, like:

- Meet environmental norms on Specific Water Consumption.
- Discharges, if any, shall be consistently as per stipulated norms, and efforts to be made to achieve quality beyond norms.

b. Identify water-related risks and its mitigation strategies.

c. Develop water management information systems, to update actual water balance three times a year (seasonal factors), to initiate timely and appropriate actions.

d. Undertake regular water audits, deliberate and act on recommendations.

4. Human Resource Development:

NTPC shall:

a. Provide specialized training to focused groups at Corporate and Station levels to meet policy objectives.

b. Provide training on water related awareness / sensitization for all employees and allied groups (Townships/Schools/CISF/Bank/Post Office etc.).

c. Subscribe and disseminate water related study reports, researches, findings, innovations through different media to all employees.

d. Encourage discussion platforms such as Professional and Quality Circles focused on water conservation and sustainability issues.

VI. Structure & Responsibilities:

Overall responsibility is vested with NTPC management, however, responsibility of implementation of this policy is primarily that of the factory occupiers under the guidance of Regional Headquarters.

Focused group structure:

1. **Corporate Centre:** A dedicated cross-functional group to be formed and responsible for:
   a. **Strategy formulation,** review and follow-up of all water management activities
   b. Design, prepare and support in formulating water budget and its implementation.
   c. Provide inputs to Sustainable Development group on water related schemes, projects, and planning.
   d. Issue necessary OGN as required from time to time.
2. **RHQs/Stations/Projects:**
   a. REDs to form appropriate dedicated teams in RHQs/Stations/Projects.
   b. HoPs shall be nodal agency responsible for implementation of all policy points at their respective stations.
   c. Reflecting site conditions, appropriate LMIs shall be issued.

VII. Commitment and Review:

NTPC commits to support and implement this Water Policy.

This policy shall be reviewed at opportune time, but not later than once in three years.

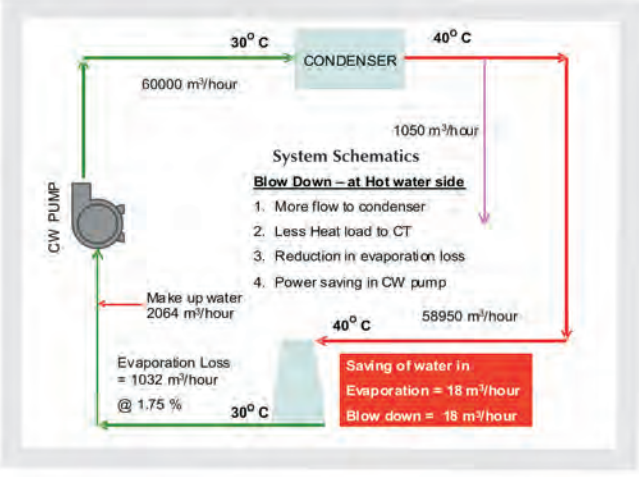
Piped water supply provided by NTPC Ramagundam in nearby village


Design
Improvement/
Retrofitting
NTPC Talcher Kaniha

Being a responsible corporate, NTPC always keeps the Environment and Natural Resource Conservation as main area of concern. The company has pioneered several design and O&M practice improvements, which have become industry benchmark. Water conservation is an area, which is close to our heart, and we have introduced several design and O&M practice changes in this arena. Some of the initiatives are as below:

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

Cooling Tower (CT) is an important component of a thermal power plant cycle which brings down the temperature of condenser cooling water (CW) so that it can be re-used in a closed cycle. When water passes through CT, there is a loss of water by evaporation, due to which salt concentration increases. To prevent this gradual escalation of salt concentration, some water is taken out continuously of the cycle(called blow down) and fresh water is introduced in the form of makeup. Generally, the blow down water is taken out from cold side of CW system to maintain desired Cycle of Concentration (COC). NTPC team came with an idea that if this blow down water is taken from hot side of water cycle (i.e. condenser outlet), the evaporation loss reduces.



The blow down water is further used as a makeup water for ash water, dust suppression in coal handling plant (CHP), fire water and service water in addition to regular make up water source. This change from cold side to hot side blow down reduces evaporation loss in CT and thus the less make up water consumption. This is being adopted as an engineering design practice in new stations and modifications are being done in existing stations.

With this practice of hot blow down and make-up water saving will be of the order of 8-10 m^3/hr at COC level of 5-6 per 500 MW unit. With a fleet size of 50,000 MW, the saving in water is estimated to be of the order of 100000 m^3/day. Equivalent fresh water can be conserved. Ramagundam, Talcher Kaniha, Solapur coal stations and Anta gas station have already achieved and implemented hot blow-down system.

High Cycles of Concentration (COC) operation in Circulating Water System

Closed cycle cooling water system with cooling towers are provided in line with the present environmental regulations. The CW System is normally designed considering a design COC of about 5 in order to optimize blow-down in coal based station. However in plants where dry ash disposal is in place COC beyond five (5) is being attempted. In Dadri and Unchahar projects, COC of 8-7.5 have been envisaged which would save about 400 m^3/hr in each station. The advanced non-chemical (galvanic) technology as well as high-end chemical (molybdate treatment) technology have been specified for achieving high COC in condenser CW circuits.

Further even more ambitious COC upto 10.5 is being targeted for various under construction bulk tender projects of 660 MW/800 MW till the installation of FGD units in these projects, resulting a fresh water saving potential upto 420-535 m^3/hr in various stations. Scheme for high COC operation has been developed for these under construction projects. Depending on the water requirement in FGD and dry ash disposal system the COC can be varied after installation of FGD.

Similar schemes for existing operating projects also are being developed.

For gas stations also, high COC operation upto 10 is being attempted in Anta, Auraiya, Kawas and Gandhar. The high TDS blow-down water is being utilized for gardening, horticulture, auto-shed wash, area-wash and township upkeep in these projects.

NTPC Dadri Power Station

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

Generally, in most of the previous sub-critical technology based thermal power plants, the excess domestic/industrial waste water after treatment in sewage treatment plant (STP) and effluent treatment plant (ETP) is being discharged into drains which eventually gets discharged into rivers/natural water bodies.

Adoption of Zero liquid discharge (ZLD) is a concept where in 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.

Our practice is to incorporate significant modifications to their original designs either in the cooling systems like - installing cooling towers in the CW system, modifications in the ash disposal systems, modifications in waste water disposal systems, independent storm water drain or others in order to achieve Zero Liquid Discharge (ZLD) and to comply with the new regulations for water use of thermal power plants (TPPs) notified by Ministry of Environment, Forests and Climate Change (MoEF&CC) on 07.12.2015.

Segregation of plant effluents, process waste, oil-sleek, coal-dust laden water from catchment rain water and their treatment & recycle for graded use of various location of power plant has been targeted to achieve ZLD in NTPC stations. Even the waste water of Flue Gas Desulphurisation (FGD) containing high Total Dissolve Solids (TDS), high chlorides and heavy metals are planned to be used in ash water system to achieve conservation and ZLD.

The Zero Discharge plan entails among several other steps as above, the following major systems:

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

NTPC stations have installed AWRS and TDR for optimization of water consumption in a closed cycle and achieving the zero liquid discharge from the ash ponds. The effluent from ash pond is recirculated back to the plant for further ash slurry makeup and again sluicing to the ash pond. In some old NTPC stations such as Singrauli, Tanda and Talcher thermal plants, where AWRS was not provided with the initial design of the main plant, but the same has been installed by us later to reduce water consumption as well as effluent discharge.

70% of Ash handling water is recirculated back to plant from ash pond resulting in marginal make-up of only about 200-300 m^3/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. In order to collect and carry the pristine storm water through separate storm water drains and also ensuring that it should not get mixed with sewage water or industrial waste water which results into increased effluent load. The modified system being implemented by us has two independent drainage systems to be constructed and runs concurrently for collection and transportation of plant effluent and storm water runoff separately. This system will result into uncontaminated Storm water which can be used as a top up water source, reduced load on sewerage/effluent treatment plant during the periods of wet weather and Optimized performance of the waste water treatment plant (WWTP)

(iv) Sewage Treatment Plant (STPs) in Townships : With the objective to achieve zero discharge of waste water in all the townships which are in construction stage, the Sewage Treatment Plant (STPs) are envisaged/ being installed which are at different stages of construction.

S.No.	NTPC Project / Stations	STP CAPACITY IN (MLD) MILLION LITRE PER DAY (1MLD = 1000 m³/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.

Even before the guidelines were framed, NTPC has been proactively working on this front. Presently MBBR (Moving Bed Bio-Film Reactor) Technology is successfully deployed for STPs in NTPC. The waste water generated in NTPC Townships is treated to comply the minimum norms of pollution control boards.

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.

Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Dissolved Oxygen (DO) etc. are achieved using various methodology of primary, secondary, tertiary treatments and aeration. These include bar screen of varying apertures, pathogens are removed using permissible chlorination.

These treated water are utilised/envisaged for following utility:

1. Horticulture - Most of the treated water is consumed in horticulture, thereby saving huge quantum of fresh water.
2. AWRS - At some places feasibility of utilising these water for Ash Water Recirculation System (AWRS) is under review at thermal stations of NTPC.
3. Flushing Water- A separate and dedicated water line system is envisaged where treated water shall be used for flushing in residential and non-residential units.

Beside waste water, the storm water is also collected through extensive network of drains and collected in reservoir or infiltrated under-ground that helps in recharging ground water.

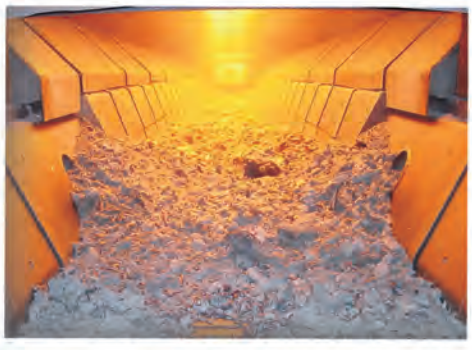
(v) Use of treated sewage water in place of fresh water : By making use of treated sewage water from Municipality wherever available near

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 m^3 /day) treated sewage will be used , whereas in Dadri 80 MLD (80000 m^3 /day), resulting saving of equal amount of fresh water on earth surface leaving it for priority use like irrigation and drinking water. Schemes for other projects are under finalisation.

The Zero Liquid Discharge concept results in conservation of water and adherence to the latest statutory regulation notified by MoEF&CC regarding water use of thermal power plants (TPPs).

Adoption of dry bottom Ash Handling System



Ash is a major by-product of coal based thermal power plants. This ash needs to be disposed away from the power plant premises. There are two fraction of ash i.e. Fly ash and Bottom ash in ratio of 80:20%. NTPC has already adopted Dry Ash Extraction System (DAES) to make the dry fly ash available to other end users. The traditional method of disposal of the ash is to make a slurry of ash by mixing with water and pumping the same to distant located "ash ponds" through long distance pipes. This process requires considerable amount of water and is known as Conventional Lean Concentration Slurry Disposal (CLSD) System. One method to reduce water consumption is the adoption of dry ash handling system in which ash is extracted and disposed in dry form using pneumatic vacuum system . NTPC has installed dry ash handling system in many of its power stations for handling the "fly ash" which is a substantial portion of the total ash generated in power station.

NTPC has gone ahead further and installed dry "bottom ash" handling system also. In Patratu and Dadri stations, such system has cut down the requirement of bottom ash handling water by upto 700 m^3/hr and 350 m^3/hr respectively on an average.

HCSD (High Concentrated Slurry Disposal)

Conventional Lean Concentration Slurry Disposal (LCSD) System and Ash Water Recovery System have limitations/ disadvantages on account of higher amount of water wastage, higher costs for ash pond construction and higher power consumption. These limitations have led to the adoption of new environment friendly ash disposal technologies like High Concentration Slurry Disposal (HCSD) Systems. This is a modern technique of disposing fly ash from thermal power plants to ash pond.

In HCSD, Ash slurry is produced at a concentration of 60% to 75% of ash by weight and pumped through piston diaphragm slurry pumps to disposal area. The

mixture behaves like semi solid and a non-newtonian fluid. The disposal of this highly viscous and non-newtonian fluid requires special type pumps. Following are the few merits of HCSD over LCSD which is attracting the more use of HCSD system.

1. Water consumption is reduced due to high concentration in HCSD (60-70%) in comparison with LCSD (15-25%). Thus, water requirement is about 1/10 in HCSD as compare to LCSD.
2. Reduces land requirement for disposal of fly ash.
3. Specific energy consumption is reduced.
4. Fugitive dust is minimal as compared to LCSD.

Thus, HCSD is environment friendly. Now a days, this system is being adopted in some coal based thermal power plants in India. At NTPC, this has been adopted at Mouda, Solapur, Kudgi and Jhajjar stations and also planned at all upcoming stations. As per MoEF&CC notification dated 7.12.2015, New plants to be installed after 1st January, 2017 shall have to meet specific water consumption up to maximum of 2.5 m^3/MWh and achieve zero waste water discharge. This system will help in achieving this goal.

Use of high efficiency Drift-Eliminators in cooling towers

Highly efficient drift eliminators of 0.001% (max. loss) in place of 0.05% are being specified and installed in recent projects like Simhadri, Khargone, Telangana etc. Water saving due to these drift eliminators, in a typical 2x660 MW station is about 70 m^3/hr

Air Cooled Condenser (ACC)

Power plants use huge amount of water as circulating water for cooling of exhaust steam coming out from steam turbines. The cooling water is generally used in a closed cycle to reduce water uses, however a certain amount of water goes out of the system as evaporation loss and some has to taken out of system as blow down to maintain cycle of concentration, which is being used in the other areas as per the quality requirements.

In water stressed or water-stretched region of the country, adoption of Air cooled condensers (ACC) can be a viable option, substituting the cooling medium for condensers totally from water to air. NTPC has been path finder in this regard by adopting 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 m^3/hr compared to about 6500 m^3/hr in a Water Cooled Condenser (WCC) based project of equivalent station capacity, thereby a saving of about 5000 m^3/hr achieved.

Rain Water Harvesting System

Rain water harvesting (RWH) is a technique of collection and storage of rainwater into natural reservoirs or tanks, or the infiltration of surface water into subsurface aquifers (before it is lost as surface runoff). One method of rainwater harvesting is rooftop harvesting. With rooftop harvesting, mostly any surface - cemented roofs, tiles, metal sheets, plastics etc can be used to intercept the flow of rainwater and retain it for recharging to the ground. NTPC has created several rain harvesting facilities in various projects across the company. Some of them are as follows.

1. Rain Water Harvesting System installed at following stations on roof top of the buildings to collect rain water and discharge to ground through filter, for recharging purpose :
   - Kahalgaon
   - Talcher Kaniha
   - Auriya
   - Faridabad
   - Simadhari
   - Korba
   - Anta

2. Station proposed for Rain Water Harvesting in FY 2017-18.
   - Anta
   - Jhanor Gandhar
   - Kayamkulam

NTPC Faridabad Gas Power Station

Water saving by improved Condensate Polishing Unit (CPU) Performance - by reducing regeneration cycle in water steam cycle of Power Plants

Condensate Polishing Unit is an online water purification system fitted in the water steam cycle to ensure quick start up and unit operation during condenser leakages etc. However, these units are required to be regenerated using chemicals such as acid and alkali, once exhausted. Generally these exhaustion and regeneration cycle happened after treating condensate @ 2 - 2.5 lac m^3 of water which is called as output between regeneration (OBR).

OBR reduced in few cases due to one or other reasons based on quality of resin, resin fouling, cross contamination, capacity reduction etc. When the number of regeneration increased from normal, the requirement of water for regeneration also increased. In general 20-30 m^3 of water required for each regeneration in addition to chemical consumption.

In Stage-II Ramagundam CPU system, it was found that the OBR was reduced to 60,000 m^3 instead of 2 lacs. Therefore, NETRA has carried out study on regeneration system and introduced an innovative method thereby increased OBR from 60,000 to 1,50,000 thus reduced number of regeneration approx 75 regenerations per annum thus saved water approx 11,250 m^3 per annum (above method is in practice since 2015, so total saving till this year is 33,750 m^3)

Optimising Cycle of Concentration (COC) of Cooling Water in CW System

Increasing the CW Cycle of Concentration is responsible for directly benefits huge saving of water. However, COC can have direct effect on corrosion and scaling potential of the circulating water and selection of appropriate COC for the CW system based on condenser material of construction along with suitable chemical treatment program so as to protect the system free from scale and corrosion problem on one hand and at the same time to increase the COC to save water along with most suitable cost effective chemical treatment program. NETRA has optimised the CW treatment and established procedures to achieve COC-5 from earlier COC-3 in many stations and recently established procedure for COC-7 and currently working towards further to achieve COC-10. Such optimisation and implementation in CW system leads to save water from 15-20 % level equivalent raw water make up has been reduced. An Approx. water saving of 4-5 lac m^3 per year due to increase in COC-5 with reduction in blow down in CW system. NETRA has further envisaged to pre-treat the make up water using cheaper technologies so as to facilitate further increase of COC thus indirectly save water.

Ash Water Ratio Reduction through Online Ultra Sonic Detection System

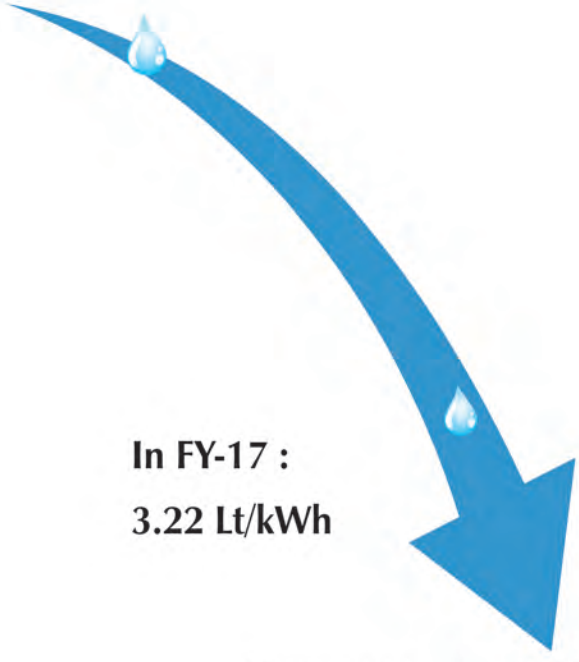
Fly ash disposal through dilution of slurry with water is followed in many coal based thermal power plants in India. In NTPC, Efforts to reduce the dilution of the slurry will result in energy conservation as well as water conservation. The latter is even more important to overcome the problem of excess water consumption.

To evaluate the effectiveness of the slurry disposal system, it is important to measure the concentration of ash in the slurry being transported through slurry disposal system. Studies are initiated to carry out measurements on line based on ultrasonic detection methods. Encouraging results are obtained from Laboratory Experiments. However, onsite experiments along with real time calibration shall optimize the method to give further validation. Attempts will be made to reduce Ash water ratio from present condition to the design value. This will further ensure reduction of water requirement in ash slurry system.

Various efforts of NTPC have resulted in reduction in water consumption

In FY-16 :

3.33 Lt/kWh



In FY-17 :

3.22 Lt/kWh

Decrease of specific water consumption as compared to previous year: 3.3%

Every drop counts


New Technology
Frontiers
NTPC Vallur

Saving of water through installation of floating solar PV plants

Floating Solar PV is an emerging renewable energy technology in which solar PV panels are installed on top of a floating platform, usually made of plastic type of material. Although the primary importance of such system is energy generation without using precious land areas, it can serve as a major means to conserve another precious resource, water, by reducing its natural evaporation rate.

Extent of saving in water evaporation is primarily dependent on the surface area of floating platform & the rate of water evaporation, which in turn is affected by various ambient factors. As per published information of National Institute of Hydrology, India, the evaporation rates closely follow climatic seasons, and reach their peak in the summer months of April and May. The annual potential evaporation ranges from 150 to 250 cm over most parts of the country. Also, it is generally observed that a factor of 0.7 is accepted as the coefficient on an annual basis.

This new concept has been utilised in NTPC Kayamkulam Power Station situated in Allappuzha district, Kerala wherein a 100 kW Floating Solar PV plant has been constructed.

NTPC Kayamkulam Power Station

In NTPC, the total available reservoir area is more than 5000 acres, spread across various power stations in India. If even half of this capacity is utilized for installing floating PV system, taking the evaporation coefficient as 0.7 and using the above mentioned evaporation rate, the potential of savings in water could be anywhere between 106 to 171 Lac m^3 annually.

With this 50% coverage and area requirement of approx. 4 acres/MW, this will also lead to an installed floating solar plants of cumulative capacity 625 MW. The average water saving per MW of installed floating solar PV system is estimated as 22000 m^3 per year.

Area of floating platform of Kaymkulam is 43x30 m and annual water saving estimate is 2260 m^3.

100 kW Floating Solar PV plant at NTPC Kayamkulam

The practice of covering water bodies to minimize evaporation loss is still relatively less used. But as water is becoming an even scarcer resource, interest in such type of initiative is bound to grow in future. Also, by shielding the water from solar radiation such floating platforms reduce photo-synthesis & weed growth, thereby improving the water quality.

Desalination of sea water and brackish water is one the feasible and attractive solutions to counter the problem of water scarcity. Although it a costly option, desalination is likely to play a major role in filling the water gap (Water without a pinch of salt - Frost and Sullivan report). In India water scarcity is higher in coastal areas in comparison to other parts of the country. Desalination water technology is widely used in water scarce states such as Gujarat, Tamil Nadu, and Rajasthan. Water produced from desalination plants can not only be used for industrial use but also for human consumption. Water desalination technology is also found to be useful for treating water from water streams.

Flue Gas based Sea-Water Desalination Plant at NTPC Simhadri

In desalination, there are four types of process which are commercially available in the market i.e. Multi-Stage Flash (MSF) desalination, multiple effect distillation (MED), MED with Vapour Compression (VC) and reverse osmosis (RO) or membrane based desalination. The major difference between these processes consists of their different input energy requirements. For MSF, MED and MED-VC the input is 'thermal energy' which could be steam or hot water. For RO or membrane based desalination, the input energy is 'electrical energy'.

In thermal energy based desalination the performance of the distillation processes is measured by a dimensionless parameter called the gain output ratio (G.O.R.), which is defined as the mass of water (in kg) which is distilled to the mass of input steam (in kg).

The feasibility of the any thermal desalination project is mainly depends upon its input heat energy. In thermal desalination, the source of motive (input) steam or hot water possibly be categorized in a four ways i.e. any external (conventional) source of heating, tapping thru power plant (if possible), renewable energy like 'solar energy' and by using 'flue gas heat' recovery.

The plant is based on flue gas based sea water desalination plant which is divided in to two parts. First is LP steam Generator Block and other is Desalination block. In is LP steam generator block the thermal energy from exhaust flue gas exiting ID Fan is utilized to generate hot water at desired temperature thru a heat exchanger. This hot water is flashed in a chamber which is maintained under vacuum to generate low pressure steam. The flash steam so generated is fed to Desalination block i.e. the first effect of Multi Effect Distillation (MED) plant. In this chamber, sea water is sprayed over LP steam piping. Due to the combined effect of high

skin temperature of the LP steam piping and vacuum in the distillation chamber, part of the sprayed sea water is evaporated. This phenomenon is of the same kind to a 'falling film reactor'. This evaporated vapour is fed to the next distillation chamber of MED where it acts as working steam and the above mentioned process is repeated. Last stage of MED is condenser was vapour generated from preceding stage is condensed. The number of effect is depends primarily on the input steam parameters and the CW inlet temperature to MED condenser. The desalinated vapours produced in various effects are condensed and send to the electrode-deionization system where it is converted to DM water.

Capacity of Plant: 120 TPD

NTPC Simhadri Power Station

Solar Thermal Sea Water Desalination (STSW-DESAL) Plant at NTECL Vallur (under construction)

Being coastal plant, NTECL Vallur has supply of sea water. RO based purification has already been installed at this station. However, a solar based Sea Water Desalination (STSW-DeSal) plant is now being constructed at this station.

STSW-DeSal plant is designed to produce potable water from sea water. This pilot plant utilizes solar thermal energy to run thermally driven machine called Multi Effect Distillation (MED) to produce distillate from seawater that will be converted to potable water after re-mineralization.

The Solar Desalination plant is divided into two parts namely LP steam Generator Block and Desalination block.

The hot water will be generated using solar thermal technology i.e. Compound Parabolic Collector (CPC). The hot water output from solar field is flashed in a chamber, which is maintained under vacuum to generate low-pressure steam. During non-solar/ low solar period, auxiliary steam will be utilized to generate hot water in a water to steam heat exchanger to achieve required temperature parameter for the process.

The flash steam generated above will be utilized as a heat source in the 1st effect of Multi Effect Distillation (MED) plant, where sea water is sprayed over LP steam piping. Due to the combined effect of high skin temperature of the LP steam piping and vacuum in the distillation chamber, part of the sprayed sea water will be evaporated. This phenomenon is similar to a 'falling film reactor'. The evaporated vapour will go to the next chamber of MED where it acts as working steam. The process is repeated in the subsequent stages of MED. Last stage of MED is a condenser where vapor generated from preceding stages is condensed. The number of effect will primarily depends on the input steam parameters and the CW inlet temperature to MED condenser. The desalinated water produced from MED will be sent to the re-mineralization plant to add necessary minerals for producing drinking water.

Capacity of Plant: 120 TPD


SOCIAL
ENDEAVOURS

Access to clean and safe drinking water round the clock may possibly be available to the well-heeled. But in the India's rustic heartland, where many of our projects are located, it is not uncommon to find thousands who struggle to get potable water. NTPC understood this problem and tried to do its bit by taking up several drinking water related projects around our projects which have resulted in substantial change in people's lives.

Provision of clean drinking water to people around NTPC projects

In the Sundargarh district of Odisha, the Kanktura High School sits in an idyllic, tree-lined plot in a remote corner of Hemgir block. Students who live in a 10-km radius trek to school, braving the vagaries of nature. The area is also part of an elephant-crossing zone, which brings its own challenges. Considering the school's inability to pay huge electricity bills a solar-powered water pump along with an RO plant has been set up at the school. The broad smiles flashed by the young girls and boys are the best proof that they are grateful for the water purifier.

The Waidhan town in Vindhya Nagar in Madhya Pradesh, situated near the Vindhyachal unit, is a typically water-deficient town facing water shortage during the scorching summers that run from April to June. Some homes have bore wells but that water quality is poor and most people rely on water from hand pumps situated kilometres from their homes.

Now, an integrated water supply system is being set up in Vindhya Nagar, with 40,000 connections. Two water treatment plants are also being set up, with a combined clear water output of 55500 m^3/day and the project is expected to cater to the projected demand until 2043.

Several other projects/steps have been taken by NTPC including -

- Installation of about 260 hand pumps at various locations near NTPC operations.
- Installation of more than 50 tube wells/bore wells, about 45 RO plants and distributions of 1500 water filters/coolers in various villages/schools near NTPC operations.
- During extreme summers water supply through water tankers provided relief to inhabitants of close to 40 villages.
- Thirty piped water schemes, renovation and restoration of about 20 water bodies taken up.
- Regular water related CSR activities around its stations covered close to 130 villages.

ATMs that quench thirst

The water ATM, set up as part of the Ramagundam unit's CSR initiative, has been operational for four years now, and over 300 households in the Annapurna Colony village use this water ATM for meeting their drinking water needs. Villagers now have the freedom of collecting two 20-litre cans of purified water every day to quench each family's thirst. The water ATM, which can store up to 2,000 litres of reverse osmosis (RO)-purified water, was set up after extensive surveys in surrounding villages highlighted the villagers' plight when it came to accessing safe drinking water. So far, 20 RO plants and water ATMs have been set up in the 20-odd villages surrounding the Ramagundam power project.

The pride of ownership that the village quality circle feels in running these water ATMs can be sensed easily. At the Annapurna Colony water ATM, the managing committee includes seven members of the village quality circle, in addition to a facilitator from NTPC and five retired NTPC employees. They pitch in with voluntary work required to keep the RO plant and water ATM running on self-sustainable basis, charging a nominal ₹ 5 per 20 litre can from the users.

Straight across the road from the Annapurna colony water ATM is a government school, which gets five cans of free water every day from the water ATM. For the students, that acts like a bonus, supplementing the free mid-day meal provided by the state. The holistic approach to problem solving is evident in the functioning of the water ATM, which generates around 50-60% waste water. This is not allowed to run off, and is instead channelized into a water pit to help recharge the water table, while some water is diverted to a drinking water trough for cattle.

Over 600 km away, in Sipat also water ATMs are being hailed by the villagers as oasis of water and healing.

Check Dams/ Ponds at NTPC – Rihand

This area faces scarcity of water for irrigation and other use round the year. Excess water during rainy season flows to Rihand dam. Check dam/ pond is a cheap and sustainable method for storage of rain water. NTPC took up construction of 7 check dams/ ponds/ water bodies at NTPC - Rihand in 5 villages – Dodhar, Nemna, Sirsoti, Piparhar and Jarha.

Outcome

- Availability of water round the year in the villages
- Irrigation enhanced agriculture produce and relief to cattle
- Water storage by check dam increases underground water level.

Broad Benefit

- Alternate way of supplying water through pipe and pump from Rihand dam is costly.
- Check dam is a cheap source of water.
- Local Community takes care of the check dams/ ponds/ water bodies.
- It provides sustainable method of irrigation for agriculture, other uses and community participation
- Total estimated no of beneficiaries are 10000

Water Body Rehabilitation

Work of Water Body Rehabilitation has been taken up by some of our Stations in the nearby villages. Stations which have completed Water Body Rehabilitation in their station/projects' side to renovate the pond surfaces and increase in water holding capacity are - Unchahar, Sipat, Solapur, Korba and Farrakka.


OTHER
INITIATIVES

Afforestation

India's rivers are dependent on rainfall. Rainfall enters rivers and streams through two main mechanisms. One mechanism is surface flow over land. The second mechanism is through underground flow. Rain seeps into soil and becomes groundwater, which then gradually flows underground and enters streams, rivers etc.

Trees help rain seep into soil because living and decaying roots make soil porous by creating a network of well-connected, minuscule channels in the soil. Rainwater seeps into soil with such channels several hundred times faster than it seeps through soil without channels.

Additionally, when plant debris falls on the soil and starts to organically degrade, it helps soil maintain integrity and form small aggregated clumps. These clumps also ensure that soil is porous thus increasing the rain water retention and flow.

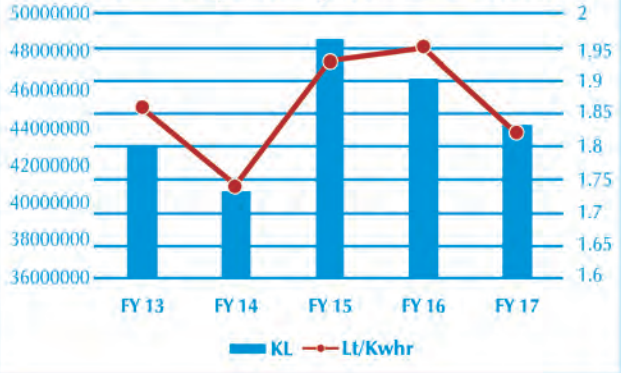
NTPC has been undertaking tree plantation covering vast areas of land in and around its projects and till date about 32 million trees have been planted throughout the country including 10 million trees planted during 2016-17 under accelerated afforestation programme. The afforestation has not only contributed to the 'aesthetics' but also helped in carbon sequestration by serving as a 'sink' of pollutants released from the stations and thereby protecting the quality of ecology and environment. Further, the Company has embarked upon long-term memorandums with State authorities to assist national commitment (NDC) in COP 21, by planning to plant 10 million trees during 2016-2026 @ 1 million trees per year across the country.

NTPC has Planted approx. 1 crore trees during 2016-17 to mitigate the GHG emissions arising out of plant operations, thereby bringing total to about 3.2 crore trees planted.

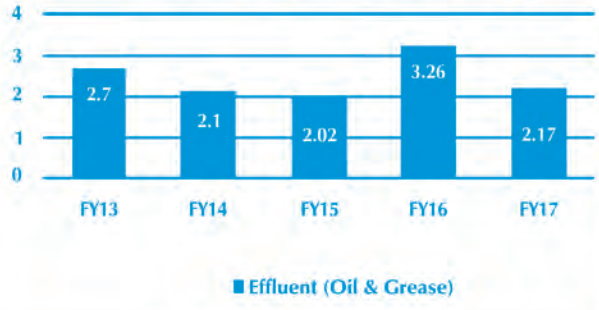
Monitoring of Effluent Quality and Quantity

Most of our stations are designed in the closed cycle system. Regarding plant effluents, NTPC has been very cautious and all efforts are being made to achieve Zero Liquid Discharge (ZLD). The effluent quantity and quality is continuously monitored. Trends of effluent generated have been provided below.

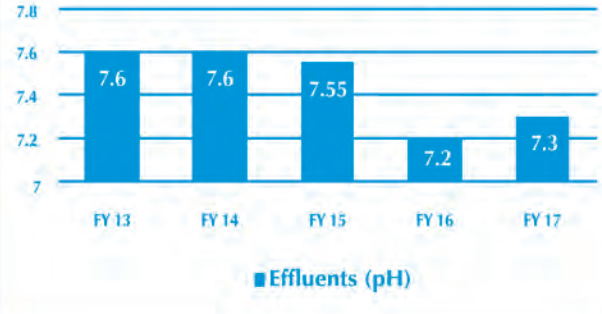
Effluents Quantity (KL & Lt/Kwhr)



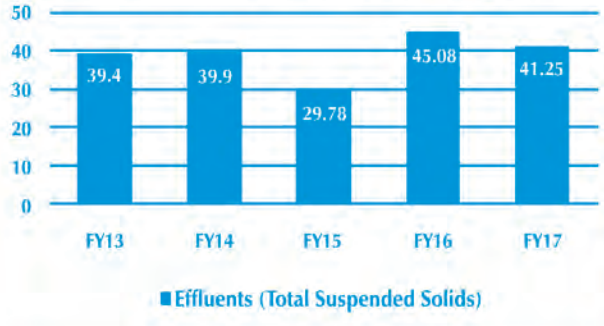
Effluents Quality (O&G) ppm



Effluents Quantity (pH)



Effluents Quality (TSS)-mg/lt



Water Helpline

Giving utmost importance to reducing wastage of water and making it a citizen centric movement, NTPC has plans to start Water Helpline in its power stations. The numbers of this Helpline will be displayed at various locations. Any person can contact the helpline if he/she observes any water leakage/loss. The complaint will be forwarded to the concerned department and will be attended promptly.

Acknowledgments

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

The Why & How of Water Saving

India - A Water Stressed Economy

17%
World Population

4%
World Fresh water

54%
India under water stress

16%
India drought prone

50%
Water shortage by 2030

65%
Indians lack easy access to water

Daily water saving tips

Save Paper

Saving 1 sheet of paper saves 5 ltrs of water

Reuse towels

Towel reuse in Hotels to save laundry water

Shower

5 min less in shower

Save up to 70 ltrs per shower

Brushing teeth

Turn off the tap

Save up to 20 ltrs per day

Toilet flush

Use water saving toilets

Save up to 700 ltrs per year

Car wash

Use bucket NOT hose

Save up to 300 ltrs per wash

Water is precious . . .
Act Now !!

Published by :

Power Management Institute

Plot No. 5-14, Sector-16A, Noida - 201301 (U.P.)

Website : http://www.pmintpc.com Email : pmi@ntpc.co.in

Design & Production : Airads Ltd., New Delhi