WATER OPTIMIZATION IN THERMAL POWER PLANTS
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AGM, NTPC
PRESENTATION OUTLINE

• Water Demand – An overview

• Water Consumption – An overview

• Water Source – Issues and Challenges
  – Scarcity of water
  – Quality of water
  – Cost of water

• NTPC – Water Management Strategies
  – Water consumption in power plant
  – Strategies to minimise water consumption
  – Technologies for minimising water consumption
  – Technologies for water reusage
  – Technologies for future

• Conclusions
WATER DEMAND – AN OVERVIEW

• India has 2.4% of the world's land resource, 16% of the world's population but only 4% of the total available fresh water.

• Per capita availability of water in 1951 was 5177 Cu.M. With increase in population per capita water availability reduced to 1650 Cu.M.

• Increasing demand and shrinking reserves need new approach to water management. Draft National Water Policy under review and consultation stresses increasing water usage efficiency by 20%.

• The new policy aims to encourage sustainable use of water by reducing wastage and promoting recycling. All sectors need to relook at its strategy in use of this precious resource.
In 1999 the National Commission on water assessed the overall availability of water, the likely demands and the implied "water available for future use". While availability will substantially reduce, survival will primarily be based on reuse.

The Surface water and groundwater are the major sources of India’s water supply. As per the World Bank report on water in India, the scenario for future water availability through these sources also portrays a trend which clearly indicates severe water scarcity in the times to come.
WATER CONSUMPTION – AN OVERVIEW

• Consumption forecast for India shows almost 30% increase by 2050.

• Sector wise rise in water consumption:
  • Population growth
  • Increase in agri based and other water intensive industries
  • Increase in food grain demand especially water intensive crops and cash crops

Figure 3: Water consumption trend

![Water consumption trend graph](image-url)
The sector wise comparison indicates:

• Decline in the share of agricultural water consumption

• Hike in the domestic consumption but a substantial threefold rise in the industrial water consumption.

• The sharp expected rise in the industrial water requirement means

  – Sector will be severely hit by the looming scarcity of the precious natural resource

  – Water Intensive industries such as power and steel necessary for infrastructure growth and back bone of developing economy would face water availability problems.
WATER SOURCE – ISSUES AND CHALLENGES

• Scarcity of Water
  – Water allocation for new projects is already emerging as a major constraint

• Depleting Quality of Water
  – Quality of fresh water is deteriorating
  – Necessity of using raw/treated sewage water

• Cost of Water
  – Lack of perennial water source calls for additional investment in infrastructure
  – Cost of existing allocated water was increasing manifolds
# WATER SOURCE – ISSUES AND CHALLENGES

## Water Tariffs of INDIAN STATES

<table>
<thead>
<tr>
<th>State</th>
<th>Industrial water tariff ,Rs</th>
<th>Date since applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gujarat</td>
<td>10/Cu. M, ↑ @10% /annum</td>
<td>01-04-2008</td>
</tr>
<tr>
<td>Haryana</td>
<td>3.53-7.06/Cu M</td>
<td>25-10-2007</td>
</tr>
<tr>
<td>AP</td>
<td>0.39-118/ Cu.M</td>
<td>02-04-2002</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>15-60/Cu.M</td>
<td>01-01-2007</td>
</tr>
<tr>
<td>Chhattisgarh</td>
<td>0.9-3.6/Cu. M</td>
<td>01-04-2006</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>0.7- 35.3/ Cu.M</td>
<td>17-05-1995</td>
</tr>
<tr>
<td>MP</td>
<td>0.02-2/Cu. M</td>
<td>01-11-2009</td>
</tr>
<tr>
<td>Orissa</td>
<td>0.15-0.66/ Cu.M</td>
<td>18-07-1998</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>2.0 - 72/Cu.M</td>
<td>01-04-2010</td>
</tr>
</tbody>
</table>
NTPC – WATER MANAGEMENT STRATEGIES

Power sector is a dominant consumer of Industrial Water

<table>
<thead>
<tr>
<th>Industry</th>
<th>Water Consumption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Power</td>
<td>87.9%</td>
</tr>
<tr>
<td>Engineering</td>
<td>5%</td>
</tr>
<tr>
<td>Pulp &amp; Paper</td>
<td>2.3%</td>
</tr>
<tr>
<td>Textiles</td>
<td>2.1%</td>
</tr>
<tr>
<td>Steel</td>
<td>1.3%</td>
</tr>
<tr>
<td>Sugar</td>
<td>0.5%</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>0.2%</td>
</tr>
<tr>
<td>Beverages</td>
<td>0.04%</td>
</tr>
<tr>
<td>Others</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

The Dominant Consumer Is Power
Water consumption in Power Plants

Table 2: Specific water consumption for power plants

<table>
<thead>
<tr>
<th>Power plant type</th>
<th>Range $M^3$/MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas based power plants</td>
<td>1.7-2.0</td>
</tr>
<tr>
<td>110 MW coal based old power plants</td>
<td>7.0-8.0</td>
</tr>
<tr>
<td>200 MW coal based thermal power plants with once trough system</td>
<td>3.0-3.5</td>
</tr>
<tr>
<td>200 MW coal based thermal power plants in closed cycle</td>
<td>4.5-5.0</td>
</tr>
<tr>
<td>500 MW coal based super thermal power plants with open cycle</td>
<td>4.0-4.5</td>
</tr>
<tr>
<td>200 MW coal based power plants with ash water recycling and closed cycle</td>
<td>3.5-4.0</td>
</tr>
<tr>
<td>500 MW coal based super thermal power plants with ash water recycling and closed cycle</td>
<td>3.0-4.0</td>
</tr>
</tbody>
</table>
STRATEGIES TO MINIMUM WATER CONSUMPTION

Water management principles need to be revisited

- Minimize fresh water drawl
- Maximize recycling and reuse
- Rethink waste water as a resource
- Differentiate among waste waters so as to treat and reuse them differently

- Water resource management to be treated not merely as a resource protection but should rather figure more prominently in any development cooperation
TECHNOLOGIES FOR MINIMISING WATER CONSUMPTION

- Supercritical units
  plant make-up < 1%

- Adoption of higher cycles of concentration (COC 4~5) to reduce blow-down water quantity
TECHNOLOGIES FOR WATER REUSE

• Recycling of plant service waste water and ash dyke water.

• Treating and reuse of Domestic sewage

• Treatment of blow down and recycle - by adopting membrane technology.
USE OF ADVANCED TECHNOLOGIES

• Adopting new technology for ash handling i.e High Concentration Slurry Disposal system (HCSD).

• Decentralized Advanced Effluent Treatment Plant

• Adopting MBR and MBBR for biological treatment

• Use of advanced chemical treatment in cooling water system enabled to maintain high COC
Case study: EXPECTED REDUCTION OF EFFLUENTS & MAKE UP WATER (1500 MW)

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Make-Up Water (cum/Hr.)</th>
<th>Consumptive Water (cum/Hr.)</th>
<th>Effluent Water (cum/Hr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Scheme</td>
<td>10925/7580</td>
<td>6685</td>
<td>895</td>
</tr>
<tr>
<td>Improved Scheme</td>
<td>10575/6670</td>
<td>6335</td>
<td>335</td>
</tr>
<tr>
<td>Zero Discharge Scheme</td>
<td>6480/5090</td>
<td>4250</td>
<td>Nearly zero</td>
</tr>
</tbody>
</table>
TECHNOLOGIES FOR FUTURE

- Water scarcity is soon going to force adoption of dry air cooled condensers and/or dry cooling towers.
- Dry cooling altogether eliminates evaporation losses that take place in wet cooling system thereby almost eliminating the need for CW make up.
Coal drying to reduce water consumption

- Use of low grade heat of hot cooling water to be used for coal drying
- Will reduce evaporation loss in cooling towers
- Use of dried coal will also enhance boiler efficiency and efficiency of power generation
Rain water harvesting is another option which needs to be exercised aggressively. The administration needs to step in and make it mandatory for all high rise buildings to have provision of storing and treating rain water. Group housing societies must necessarily have the facility of collecting & treating rain water at least to make it fit for non-drinking uses.
TECHNOLOGIES FOR FUTURE

• Coastal Power stations with once through sea water cooling system to be encouraged which will substantially reduce dependence on fresh water.

• Coastal Regulations pose serious problem in siting of power plants and needs amendment to meet power and water related challenges
CONCLUSION

• Power Plants are the largest consumer of water in the industrial sector.

• All efforts need to be made to minimize use of fresh water both on technology as well as legislation front.

• We at NTPC are committed to minimize use of fresh water for power plants through recycling, reuse and adoption of water efficient technologies.
THANK YOU