Agility
Care
Integrity
Excellence
Collaboration
Trust
Respect

Water Consumption in Thermal Power Plants

TATA POWER
Lighting up Lives!

New Specific Water Consumption Norms

Industry	Parameter	Standards
Thermal Power Plant (Water consumption limit)	Water consumption	I. All plants with Once Through Cooling (OTC) shall install Cooling Tower (CT) and achieve specific water consumption up to maximum of 3.5m3/MWh within a period of two years from the date of publication of this notification. II. All existing CT-based plants reduce specific water consumption up to maximum of 3.5m3/MWh within a period of two years from the date of publication of this notification. III. New plants to be installed after 1st January 2017 shall have to meet specific water consumption up to maximum of 2.5 m3/MWh and achieve zero waste water discharged.

Effect on Tata Power

Current Status and Path forward for CGPL – Unit 10 to 50

Plant & Unit Description	Applicable Norm	Current Status & Action Plan	Remarks
5x830MW Unit # 10 COD – 7th Mar 2012 Unit # 50 COD – 22 Mar 2013	OTC to CT based cooling water system	Detailed feasibility study is being taken up. However, even with cooling towers, meeting the specific water consumption of 3.5m3/MWh is not possible.	Given the technical CoC limitation of 1.5, it is technically impossible for sea water based plants to achieve the norm of 3.5 m3/MWh (with COC of 1.5, the specific water consumption achievable is more than 8 m3/MWh)

Current Status and Path forward for Trombay Unit 5

Plant & Unit Description	Applicable Norm	Current Status & Action Plan	Remarks
1x500MW CoD – 25 Jan 1984. Completed 32 years	OTC to CT based cooling water system	Implementation of cooling towers is not feasible due to space constraints	• Station is planned within 0.27 acres/MW as against CEA norm of 0.42 acres/MW for coastal plants • Condenser replacement reqd

Current Status and Path forward for Trombay Unit 6

Plant & Unit Description	Applicable Norm	Current Status & Action Plan	Remarks
1x500MW CoD – 23rd Mar 1990. Completed 26 years.	OTC to CT based cooling water system	Implementation of cooling towers is not feasible due to space constraints	• Station is planned within 0.27 acres/MW as against CEA norm of 0.42 acres/MW for coastal plants.

Current Status and Path forward for Trombay Unit 8

Plant & Unit Description	Applicable Norm	Current Status & Action Plan	Remarks
1x250MW CoD – 29th Mar 2008	OTC to CT based cooling water system	Installation of cooling towers may be possible, it will not result in reduction in sea water requirement as operation of sea water based FGD would be essential to meet norms related to SO2 emissions, which is presently draws water from CW outlet.	The min specific water consumption achievable with Cooling towers make up and plant water requirement will be higher than 8.m3/MWh.

Current Status and Path forward for Maithon Station

Plant & Unit Description	Applicable Norm	Current Status & Action Plan	Remarks
2x525MW CoD U1 – 1st Sept 2011 CoD U2 – 24th Jul 2012	Specific water consumption upto maximum of 3.5m3/MWh	Meets new norms	No action required.

Current Status and Path forward for Jojobera Unit # 1 to 3

Plant & Unit Description	Applicable Norm	Current Status & Action Plan	Remarks
U1 Size – 67.5 MW U2 Size – 120 MW U3 Size – 120 MW CoD U1 – 1st Apr 1997 CoD U2 – 1st Feb 2001 COD U3 – 1st Feb 2002	Specific water consumption up to maximum of 3.5m3/MWh	Meets new norms	No action required.

Current Status and Path forward for Jojobera Unit # 4 & 5

Plant & Unit Description	Applicable Norm	Current Status & Action Plan	Remarks
U4 Size – 120 MW U5 Size – 120 MW CoD U4 – 23rd Nov 2005 CoD U5 - 27th Mar 2011	Specific water consumption upto maximum of 3.5m3/MWh	Meets new norms	No action required.

Agility
Care
Integrity
Excellence
Collaboration
Trust
Respect

Conversion from Sea Water Based Once Through CW system to Cooling Tower Based CW System

TATA POWER
Lighting up Lives!

Comparison of Cooling Tower Technologies

Description	NDCT	IDCT
Layout	Tower requires greater area due to lower water loading	Tower requires smaller area due to higher water loading
Part Load Operation	Operates at design heat load.	Can operate at various load conditions
Volume of water handled	Generally suitable for large water flows	Suitable for all water flows
Facility to enhance capacity	Capacity cannot be enhanced once the tower is built.	Capacity can be increased at a later stage
Effect of Relative Humidity	Tower sizing is directly affected by relative humidity of the inlet air	RH has very negligible effect on performance once the inlet WBT is fixed.
Maintenance	Difficult to maintain due to access restrictions.	Easier to maintain due to lower heights.

Comparison of Cooling Tower Technologies

Description	NDCT	IDCT
Cost	NDCT is at least 1.6-1.8 times in construction cost.	Initial cost is much lower. Aux power cost needs to be considered for lifetime.
Aux Power Consumption	No aux power consumption	Typically about 0.5% of Unit size.
Unequal water and air loading	Possibility of unequal water and air loadings exist due to very large size of the tower which affects the effectiveness.	IDCT sizes are limited to 20 to 22m, hence, unequal water distribution phenomena does not affect effectiveness.

Cost Estimates for Cooling Tower

Attributes	Description
Capital Cost	Estimated at about Rs 0.3 to 0.4 Crores / MW.
Aux power consumption	Estimated at about additional 0.6% of station/Unit including additional power for pump.
O&M cost per annum	Estimated at about Rs 0.002 Cr/MW.

Challenges for Installation of CTs

Challenges	Description
Layout	• Plants which are 20-25 years old and have once through cooling water system, no space had been envisaged for installation of CT. • Approx area of 2 acres will be required for installation of CT for 500MW Unit. Additional land for electrical equipment, pump house, fore-bay, chemical dosage facility etc will also be required.. • Even if, by any means, space required for installation of CTs is identified, locating of CT w.r.t direction of wind, effect of mist on switchyard, re-circulation etc may not be suitable. • For 500MW Unit, the CW pipe of 3.2 metres dia is required. Routing of such huge dia pipe within the existing under-ground facilities may not be feasible without long outages of Unit.

Challenges for Installation of CTs

Challenges	Description
CoC for Sea water	Sea water has Total Dissolved Solid (TDS) concentration ranging from 35000 ppm to 47000 ppm. Max CoC achievable for sea water based cooling towers is about 1.5. Therefore even with installation of cooling towers, specific sea water consumption for a 800MW along with plant water requirement will be above 8m3/MWh and **technically** it is not possible meeting limitation of 3.5 m3/MWh.
Aux Power Consumption	Installation of Cooling Tower will result into higher aux power consumption. Additional aux power consumption of approx. 0.5% to 0.7% of Unit capacity is estimated.
Effect on Existing Condenser	Cooling Tower will require higher discharge head pump. This will subject existing condenser to higher pressure compare to its present design value warranting its replacement in case margins are not available. Estimated outage time required more than 3 months.

Challenges for Installation of CTs

Challenges	Description
Retrofit issues	The plant electrical system will have to be augmented to provide the additional auxiliary power required for cooling towers. Modification to existing cooling water system is required, which will result into station/unit outage.
Impact on Sea water FGD	If cooling towers are to be installed with plants having OTC system with sea water, the sea water based FGDs, which are most economical and eco-friendly, will have to be shut or will not be feasible.

Agility Care Integrity Excellence Collaboration Trust Respect

Methods of Reduction of Specific Water Consumption for Fresh Water Cooling tower based Stations

TATA POWER
Lighting up Lives!

Methodologies for Reduction of Specific Water Consumption

Recycling and Reuse: Recycle and reuse of waste water shall be adopted to minimize the fresh water consumption. In this philosophy, the waste water generated in one system is reused in some other systems/applications wherever such quality of water is permissible to use.

Methodologies for Reduction of Specific Water Consumption

Sl.No	Waste water	Characteristics	Possible use or action	Remark
1.	Cooling tower blow down	Low TSS Moderate TDS High temperature	Ash handling Coal dust suppression	
2.	Back wash water from filtration unit	Moderate TSS Low TDS	Recycled in plant clarifier	
3.	Back wash from side stream filter of cooling tower	High TSS Moderate TDS	Recycled in plant clarifier	Need to be treated in a sludge removal system (sludge clarifier, thickener and dehydrator)
4.	Floor wash	Moderate TSS Low TDS	Recycled in ETP	

Methodologies for Reduction of Specific Water Consumption

Sl.No	Waste water	Characteristics	Possible use or action	Remark
5.	Sewage	Moderate TSS Low TDS High BOD	Gardening	To be treated in sewage treatment plant and the clear water can be reused
6.	Regeneration waste from DM plant	Low TSS High TDS	Product water can be used as fresh water	To be treated in ZLD/ Reuse in ash slurry preparation

Detailed study for the above options needs to carried out before adoption.