“ENVIRONMENTAL STANDARDS, WATER EFFICIENCY, CHALLENGES AND WAY FORWARD FOR THERMAL POWER PLANTS”

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Environmental Standards for Thermal Power Plants

1. **Short title and commencement**.– (1) These rules may be called the Environment (Protection) Amendment Rules, 2023.

(2) They shall come into force on expiry of period of two years from the date of publication of this notification in the Official Gazette.

2. In the Environment (Protection) Rules, 1986, in Schedule-I,- (a) for serial number 70 and entries relating thereto, the following shall be substituted, namely:-

S. No.	Industry	Parameters	Type of industrial boiler (fuel-wise) and Standards	
(1)	(2)	(3)	(4)	
"70.	Boilers (Steam generation capacity, ton/hour)	Particulate Matter (PM) Emission (mg/Nm^3)	Agro based fuels/bagasse	Other fuels
	• Less than 2 • 2 to less than 10 • 10 and above		$500\ mg/Nm^3$ $250\ mg/Nm^3$ $250\ mg/Nm_3$	$500\ mg/Nm^3$ $150\ mg/Nm^3$ $100\ mg/Nm^3$

Notes:

(i) Minimum stack height (in meter) shall be as per the formula, namely:-

$H=14Q^{0.3}$ (where Q is SO_2 emission rate in kg/hr); or

$H=74Q^{0.27}$ (where Q is PM emission rate in tonne/hr), whichever is more.

However, in no case the stack height shall be less than 11 m for boilers of < 2 ton/hour steam generation capacity and 30 m for boilers of higher steam generation capacity.

(ii) Measured values of PM, SO_2 and NOx to be normalised at 6% O_2 for solid fuels and at 3% O_2 for liquid fuels, on dry basis, for comparing with above standards, as below, namely:-

Normalized value = Measured value × [(21- Ref O_2 at 6 or 3 %) / (21 - measured O_2 in %)]

S. No.	Industry	Parameter	Standards
1	2	3	4
5.	**Thermal Power Plants**		Maximum limiting concentration, milligrams per litre (except for pH and temperature)
	Condenser Cooling waters (once through cooling system)	pH	6.5-8.5
		Temperature	Not more than 5 ^{0}C higher than the intake water temperature
		Free available chlorine	0.5
	Boiler blow down	Suspended Solids	100
		Oil and Grease	20
		Copper (total)	1.0
		Iron (total)	1.0
	Cooling tower blow down	Free available chlorine	0.5
		Zinc	1.0
		Chromium (total)	0.2
		Phosphate	5.0
		Other corrosion inhibiting material	Limit to be established on case by case basis by Central Board in case of Union territories and State Board in case of States.
	Ash pond effluent	pH	6.5-8.5
		Suspended solids	100
		Oil and Grease	20

[1][5A.	**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 upto maximum of 3.5m^3/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 upto maximum of 3.5m^3/MWh within a period of two years from date of publication of this notification. [2]{III. Specific water consumption shall not exceed maximum of 3.0 m^3/MWh for new plants installed after the 1st January, 2017 and these plants shall also achieve zero waste water discharged}.

Items I to III in column 4 in serial number 5A above shall not be applicable to the Thermal Power Plants **using sea water]**

[1] Inserted by S.O. 3305(E), dated 07th December, 2015 serial no. 5A and their entries relating thereto

[2] Substitute by G.S.R. 593(E), dated 28th June, 2018

Present Status of Water Efficiency in Thermal Power Plants

Thermal power plants are among the largest consumers of freshwater globally, especially in regions where water-intensive cooling systems are employed. Efforts to improve water efficiency in these plants are increasingly important due to growing water scarcity and environmental concerns.

1. Water Consumption Trends

- Thermal power plants consume significant amounts of water for cooling, steam generation, ash handling, and other processes.
- Plants equipped with once-through cooling systems have higher water withdrawal but lower consumption, whereas closed-loop systems use less water overall but with higher consumption due to evaporation.

Advanced cooling technologies, such as dry cooling systems, are being adopted in water-stressed regions, but they are costlier and less efficient in terms of energy output

2. Technological Developments

•Increasing use of supercritical and ultra-supercritical boilers, which require less water per unit of electricity generated.
•Deployment of zero-liquid discharge (ZLD) systems in some regions to minimize wastewater discharge.
•Integration of wastewater recycling and reuse systems, such as using treated municipal or industrial wastewater.

3. Regulations and Standards

•Many countries have introduced regulations to limit water consumption and improve water efficiency in thermal power plants.
•In India, for instance, the Ministry of Environment, Forest and Climate Change (MoEFCC) issued norms for specific water consumption limits for thermal power plants.

- **In 2015 Ministry of Environment, Forest and Climate Change (MoEFCC) Notification:** This directive mandates that all existing cooling tower-based thermal power plants reduce their specific water consumption to a maximum of 3.5 cubic meters per megawatt-hour (m^3/MWh) within two years of the notification. New plants installed after January 1, 2017, are required to limit their water consumption to 3.0 m^3/MWh.

Current Water Consumption Metrics:

- **Average Consumption:** The average water consumption in Indian thermal power plants varies, with some reports indicating figures around 4.0 m^3/MWh. In comparison, Chinese & some Indian thermal power plants have an average consumption of approximately 2.5 m^3/MWh, highlighting the potential for improvement in other TPP in India.

Cooling Towers: Cooling towers account for about 80% of the total water consumption in coal-fired thermal power plants. Implementing advanced cooling technologies, such as air-cooled condensers, can significantly reduce water intensity to between 0.45 and 0.65 m^3/MWh, albeit with higher initial capital costs.

Despite improvements, several **challenges** remain:

1. Technological Barriers

•Transitioning to advanced cooling technologies (e.g., dry cooling or hybrid cooling) , **can reduce water consumption but** is expensive and less efficient in hot climates.

•Retrofitting older plants to meet modern water-efficiency standards can be technically challenging and financially prohibitive.

2. High Costs

•Water-efficient systems and wastewater recycling technologies require substantial capital investments.

•Operating costs for systems like ZLD are high, making them less feasible for smaller plants.

3. Water Scarcity and Competition

•Thermal power plants in water-scarce regions face intense competition with agriculture and urban water demands.

•Decreasing water availability due to climate change exacerbates these challenges.

4. Regulatory Compliance

•Compliance with stringent water-use regulations can be difficult, especially for older plants with outdated infrastructure.

•Lack of enforcement in some regions hinders widespread adoption of efficient practices.

5. Lack of Awareness and Capacity

•In some developing regions, there is limited awareness of the benefits of water efficiency.

•Limited technical expertise and insufficient training in implementing advanced water management systems.

6. Energy-Water Nexus

•There is often a trade-off between water efficiency and energy efficiency, as some water-saving technologies require additional energy input.

7. **Water Scarcity:** Approximately 40% of India's thermal power plants are situated in water-scarce regions, making efficient water use crucial for their sustained operation.

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Way Forward

- **Policy Incentives**: Governments should incentivize water-efficient technologies through subsidies or tax breaks.

- **Research and Development**: More focus on cost-effective and region-specific solutions, such as hybrid cooling systems.

- **Capacity Building**: Training programs for plant operators on water management best practices.

- **Integrated Resource Management**: Adopting an integrated approach to manage water, energy, and emissions collectively.

By addressing these challenges, thermal power plants can achieve greater water efficiency, contributing to sustainability and reduced environmental impact.

Thank You

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