Declining Efficiency of Mettur Thermal Power Station: Reasons, Risks and Remedies?

Abstract

Energy plays a vital role in supporting the economic growth of Tamil Nadu. Coal-fired plants have been contributing to the bulk of the electricity generated in this state for over fifty years now. However, the constant burning of coal, increasing water utilisation, and release of fly ash and toxic gases like SOx and NOx are stressing the livelihood of communities living in proximity to the plant.

This study is focused on the qualitative and quantitative analysis of operations of the 1,440 MW coal-fired plant in Mettur, in terms of its coal consumption, energy generation, fly ash production and utilisation, and most importantly, water utilisation. It is observed that the plant has been operating in violation of the Environment (Protection) Amendment Rules, 2014, Fly Ash Utilisation Notification, 2009, MoEFCC Notification in 2015 on water utilisation, and the National Tariff Policy, 2016. Since energy generation by old and inefficient coal-fired plants like the four units (4X210MW) of the Mettur Thermal Power Station has a massive load on the environment and natural resources, these should be decommissioned and subsequently replaced with clean energy sources like solar power. This shift will help the State to meet its energy demands in a more sustainable fashion.

Introduction

The Mettur Thermal Power Station (MTPS) was established as the first inland thermal power plant of Tamil Nadu Electricity Board in 1987 (and it is presently run by its subsidiary Tamil Nadu Generation and Distribution Corporation Limited - TANGEDCO). The MTPS (indicated by a purple arrow) is located in Salem[1] district and has been constructed at 1.4 km from the bank of Cauvery river and 500 meters away from its narrow diversion (see figure 1).

Since the core zone of MTPS is located in close proximity to the Cauvery river, the plant has a very high impact[2] on the aquatic ecosystem, whereas the fly ash affects both the water and land ecology, and neighbourhood residents' health due to air pollution. Besides, it affects the livelihood of farmers and fishermen by depletion in the quality and quantity of water in Cauvery river, which is the power plant's only source of water.

[1]https://www.twadboard.tn.gov.in/content/salem

[2]https://www.thermalwatch.org.in/environmental-impact-assessment/impacts-power-plants

Figure 1: Distance measured between MTPS and Cauvery river on Google Earth.

Indigeneous and imported coal is used for the station, and is discharged at Ennore port and transported to MTPS through rail wagons. The electricity generated by the MTPS is utilised in Tamil Nadu, thus playing a significant role in meeting the state's power demand[3]. The basic details of the plant are mentioned below.

Unit	Commissioning year	Capacity (MW)	COAL		
			Source	Ratio of imported and Indian coal in FY19	Average ash content (%) in FY19
MTPS I[4]					

[3]https://www.thehindu.com/news/national/tamil-nadu/tn-registers-all-time-high-power-demand-of-15689-mw/article26476652.ece
[4]https://www.tangedco.gov.in/linkpdf/tmtps.pdf

1	1987	210	Indian coal from Mahanadi coalfields Limited (Talchar & IB Valley), Orissa, Eastern coalfields Limited and Ranikanj, West Bengal.	5:18	39.06
2	1987	210			
3	1989	210			
4	1990	210	Imported coal (Indonesia)		9.76
MTPS II[5]					
5	2013	600	Indian coal from Mahanadi coalfields Limited (Talchar & IB Valley), Orissa, Eastern coalfields Limited and Ranikanj, West Bengal.	3:8	42.92
			Imported coal (Indonesia)		11.54

Table 1: Overview of MTPS I and MTPS II

Methodology

The study has been done to capture the performance of both phases of MTPS based on the data consolidated and analysed through various sources. The qualitative data has been reviewed from reports, news articles and information available on official websites of MoEFCC, CEA and TNPCB; the quantitative data has been obtained from TANGEDCO's website, Environmental Statements (ES) for MTPS I and MTPS II submitted by TANGEDCO, and the reports published by the Central Electricity Authority (CEA).

Results and Discussion

1. **Performance of MTPS:** The Plant Load Factor (PLF)[6] of a coal-fired plant is the ratio between the amount of electricity generated by a plant to the amount of electricity it could have generated under ideal conditions. According to data obtained from the Load Generation Balance Report of CEA, the average actual electricity demand in Tamil Nadu was 262.35, 286.33, 290.43 and 299.95 MU/day, indicating a steady increase from 2015-2019. However, according to data provided in the respective ES for year 2015-16, 2016-17, 2017-18 and 2018-19, the production by MTPS I has been significantly lower than its capacity of 840 MW with a PLF of 81%, 77.88%, 69.39%, and 78.92%. Even the

[5]https://www.tangedco.gov.in/linkpdf/tmtps.pdf
[6]https://www.thermalwatch.org.in/resources/plant-load-factor

more recently commissioned unit of the power plant, MTPS II with a capacity of 600 MW, operated with a low PLF of 74.49%[7], 65.55%, 67.5% and 79.74%. The performance of both MTPS I and MTPS II appears to be fluctuating, with neither plant yet working at an optimal capacity (see figure 2).

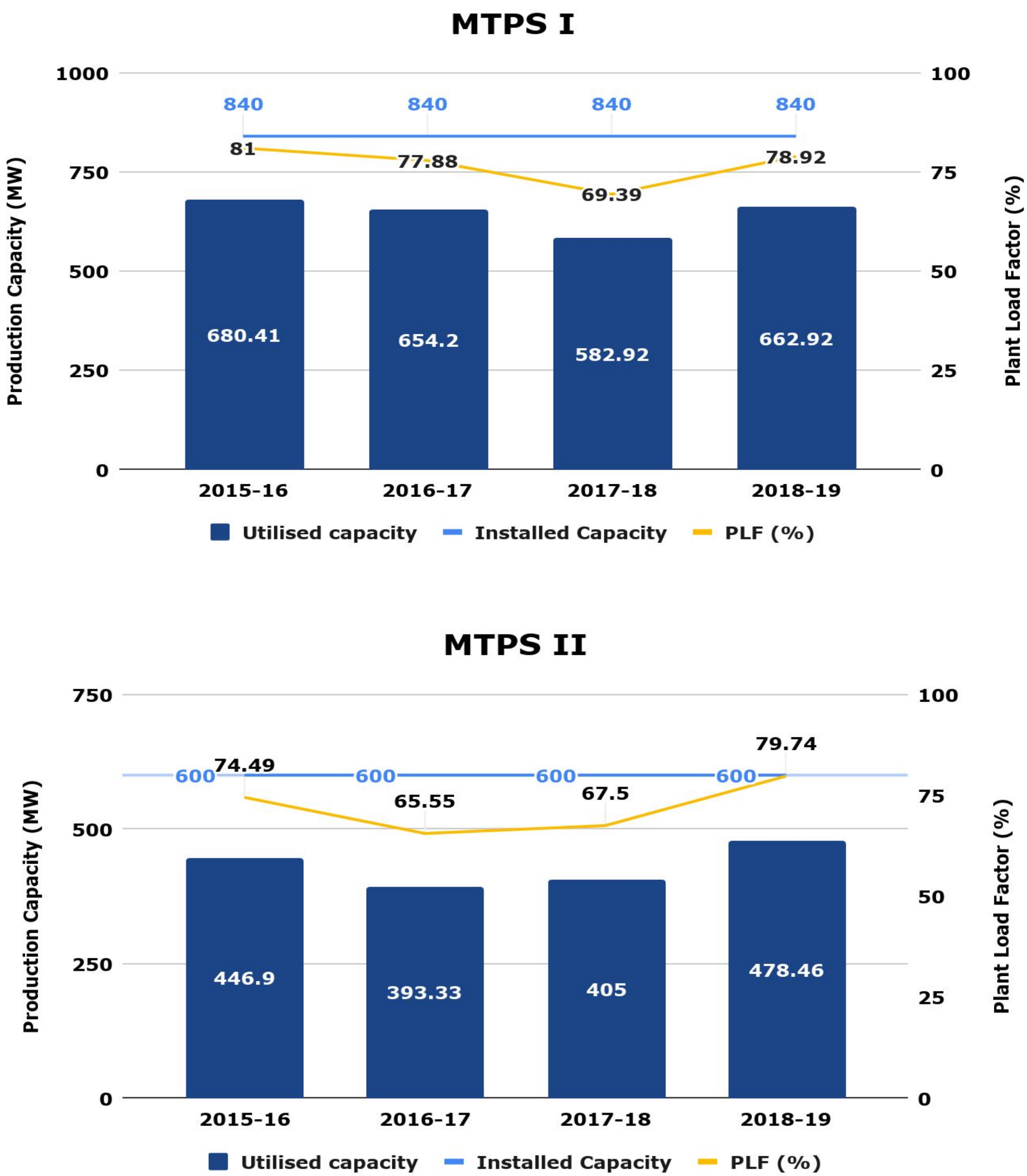


Figure 2: Actual production vs installed capacity (MW) for the four years.

[7]https://www.tangedco.gov.in/linkpdf/mtps2.pdf

2. **Coal consumption and ash content in coal:** Through the analysis of ES, it was found that in 2015-16 ash content of coal used in MTPS I was 33.28%, after which it rose to 35.12%, 34.86% and further reduced to 32.16% in 2018-19. At MTPS II, the ash content of coal had risen from 27.36% to 35.91% in the same period which is beyond the 34% limit stipulated in its Environmental Clearance (EC). Also, this violates the stipulation in the Environment (Protection) Amendment Rules, 2014 which stipulates the same criteria of ash content under 34% (see figure 3).

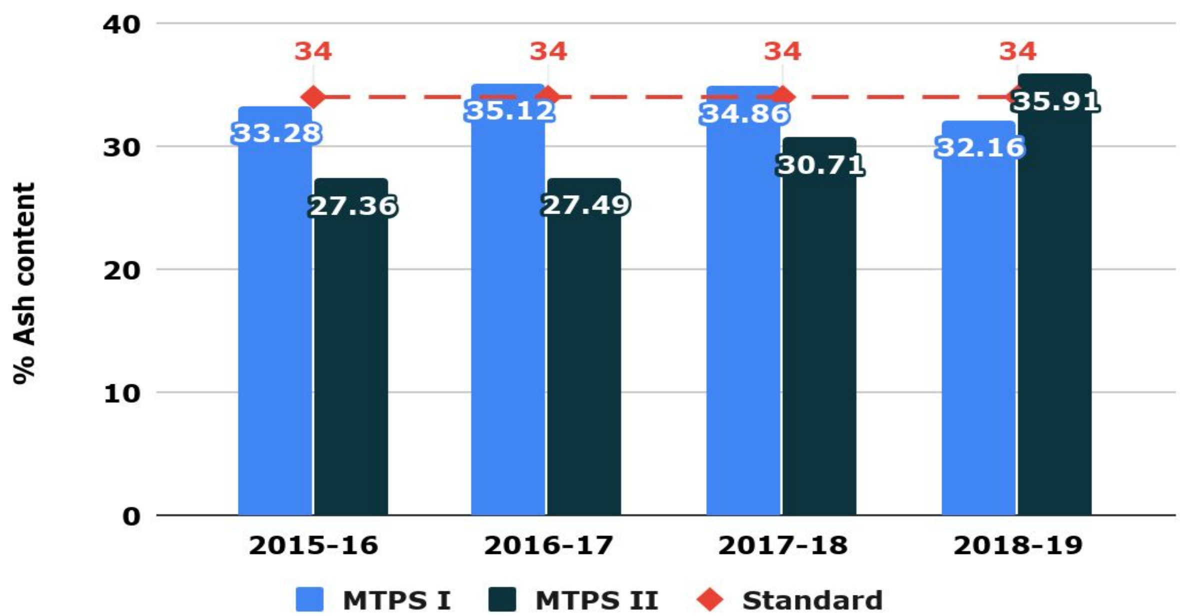


Figure 3: Percentage (%) of ash content in coal.

It was observed that the efficiency of power generation in Units Per Kilogram (units/Kg) of coal consumed for MTPS I was 1.43, 1.40, 1.42, and 1.43, and for MTPS II was 1.58, 1.51, 1.46 and 1.45 from year 2015-19. In simple terms, it means that for each kilogram of coal consumed, the units generated by the power station was constant for MTPS I and had decreased for MTPS II in respective years. This, when seen with the use of coal with higher ash content, indicates that the efficiency of the plant has been adversely impacted by using coal with a higher ash content.

3. **Ash generation and utilisation:** All coal power plants are required to completely utilise the fly ash generated by them. As for MTPS, it is observed that the highest level of fly ash generated, 1.44 million tons (MT) in MTPS I, was in 2016-17 and its utilisation was the highest, 132%, in the year 2015-16. This could be due to utilisation of 0.465 MT of fly ash from the 18.53 MT of ash available as balance stock from previous years. In MTPS II, the generation of fly

ash was highest (0.71 MT) in 2018-19 and its utilisation was the highest, 98.19%, in 2016-17 (see figure 4).

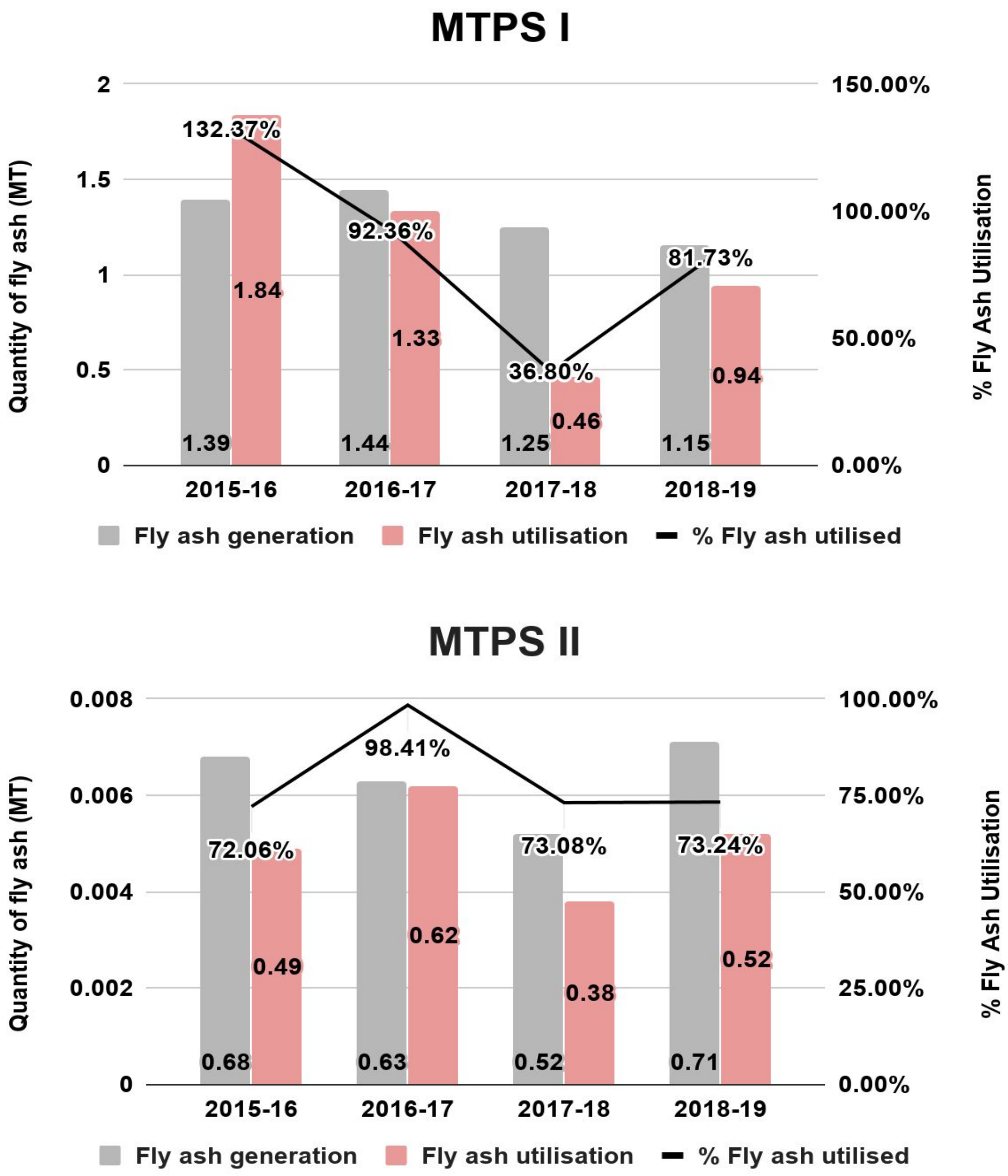
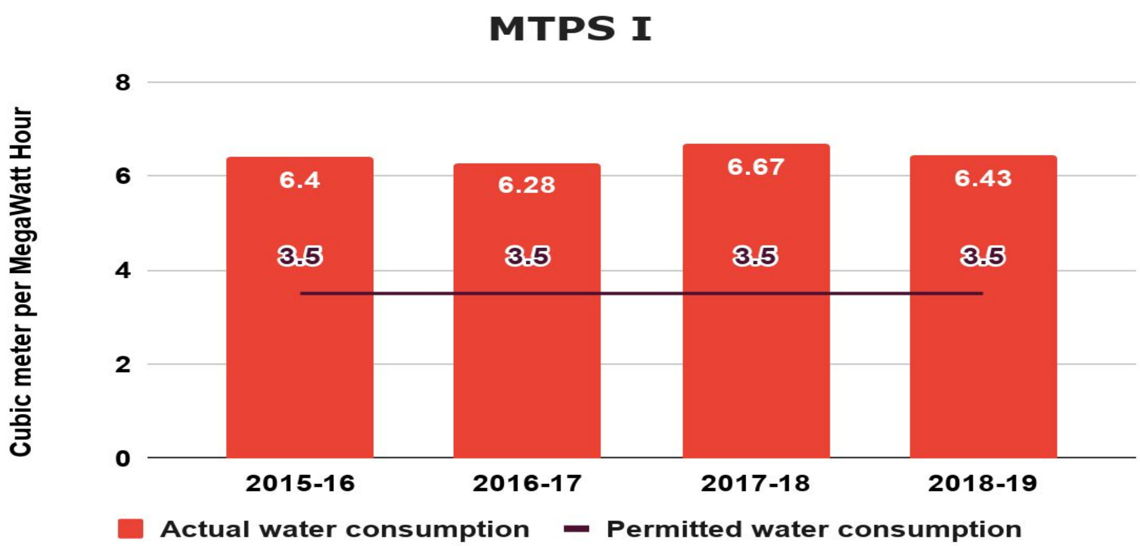


Figure 4: Fly ash generation (MT) vs fly ash utilisation (MT).

In 2017-18, fly ash utilisation reduced to 36.80% and 73.08% in MTPS I and MTPS II respectively, which is a violation of the 100% fly ash utilisation target that had to be achieved from 2014 onwards stipulated through a Notification in 2009. In case of MTPS II, it is also a violation of the EC condition where it is stipulated that "100% utilisation of fly ash shall be achieved from day one".

4. **Water utilisation:** For every megawatt hour, a coal-based power plant is mandated to use only up to 3.5 cubic metres of water, as per MoEFCC notification in 2015. In a flagrant violation of this rule, MTPS I has been consuming nearly twice this amount. In contrast, in MTPS II, water consumption is much lesser and within the stipulated limit. An analysis of the water utilisation for MTPS I showed that the water consumed for process, cooling and domestic purpose is 182.90% (2015-16), 179.50% (2016-17), 190.67% (2017-18) and 183.59% (2018-19) of the permitted limit (see figure 6).



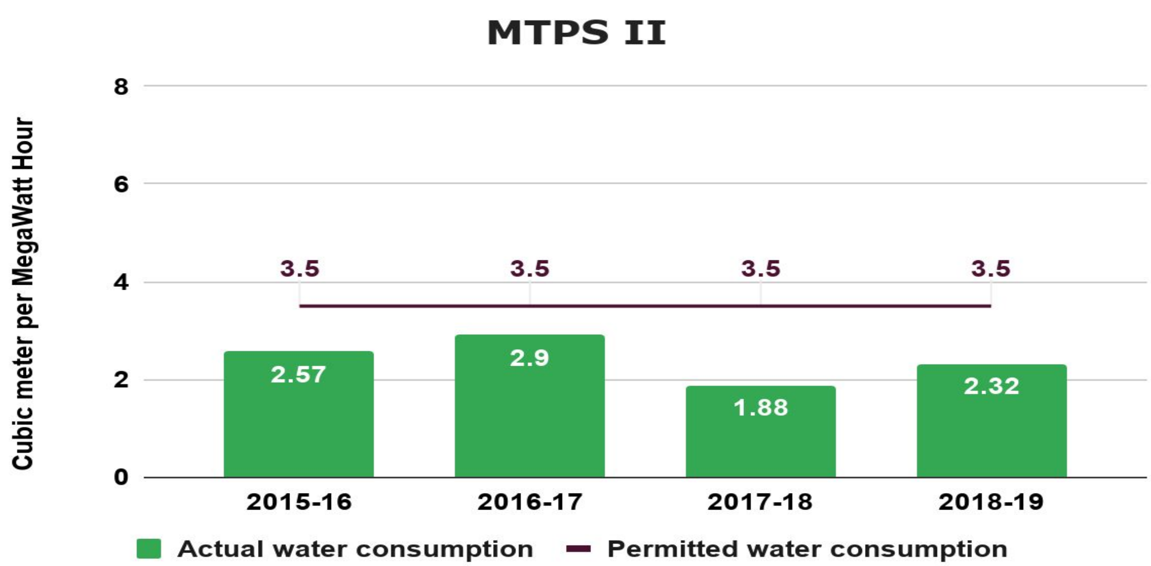


Figure 6: The water consumed in MTPS I and MTPS II.

Since coal power plants are water-intensive, the National Tariff Policy in 2016 required all coal plants to use treated water if there was a Sewage Treatment Plant within a 50 km radius. This then mandates that MTPS meet its freshwater requirement from the sewage treatment plants (STPs) of Mettur municipality with a capacity of 6,374 KLD[8] working within a 50 km radius of MTPS. The STP pointed with yellow arrow is located 2.84 Km from MTPS (see figure 7). However, as per the documents provided to us, MTPS does not use the treated water, and instead relies on Cauvery to meet its water requirement.

Figure 7: Distance measured between MTPS and Mettur Sewage Treatment Plant on Google Earth.

Conclusion

This study establishes falling efficiency of the four units of MTPS I, which have been operating for 29-32 years now, and the nearly 6 year old unit of MTPS II, as observed in the study period. Despite the fact that efficiency in MTPS I seems to have marginally improved this year, it is low compared to 2015-16 and 2016-17. Further, it has been observed that MTPS II, although a recently commissioned plant, has been performing sub-optimally, recording a PLF of about 79.74% so far this year. The power plant is operating in violation of multiple rules and standards, summarised below:

1. Utilisation of coal with ash content higher than 34% ash content transgress the Environment (Protection) Amendment Rules in 2014.

[8] https://www.tnpcb.gov.in/pdf_2019/PrsCauvery24919.pdf

2. Non-compliance with 100% Fly Ash Utilisation notification, 2009 even 5 years after the deadline.
3. Negligence in the norm of 3.5 cum/MWh water utilisation in line with MoEFCC notification in 2015, and
4. Operating in violation of the National Tariff Policy, 2016 by not utilising treated sewage water for the plant.

The poor performance of MTPS is intensifying the depth of consequences like water crisis[9], air pollution and deterioration of the three ecologically sensitive areas- Vanavasi, Gonur and Mettur Palamali reserved forests -within 25 kilometers radius from the plant. Moreover, it is stressing the water of Cauvery[10], a major river and source of livelihood for farmers, fishermen and others living along the river bank in Salem district and for a number of miles in the other downstream districts[11] of Tamil Nadu.

This provides a compelling reason to expedite the process of decommissioning[12] the four units of MTPS I in line with the note of CEA, which suggests retirement of plants which are inefficient or older than 25 years. Instead of planning to commission more power plants, the state utility should channelise its efforts in improving the efficiency of existing plants such as MTPS II. Although, the decommissioning of MTPS I will decline its installed capacity by 58.33%, it will significantly decline the freshwater utilisation by 79.96%, coal consumption by 64.88%, and fly-ash generation by 67.30% (see Annexure I). Following the analysis, we propose the following as the way forward:

- Decommission the four units (4X210MW) of MTPS I.
- In its mainland, install a 22 MW linear fresnel concentrated solar power (CSP) plant[13] along with a thermal energy storage (TES) which operates with 50% Capacity Utilisation Factor (CUF)[14].
- Improve the PLF of 600 MW MTPS II to develop an efficient coal-solar hybrid system[15] with this 22 MW CSP plant.
- Establish the proposed 100 MW[16] floating solar photovoltaic (FSPV) which operates with a CUF of 35% over the Stanley reservoir[17] of Mettur Dam.

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[9] https://www.indiatoday.in/india/story/tamil-nadu-water-crisis-dead-fish-wash-up-taps-go-dry-chennai-water-shortage-1553152-2019-06-2

[10] https://www.academia.edu/10449260/Impacts_of_Coastal_Coal_Based_Thermal_Power_Plants_on_Water_Report_of_Visit_to_Some_Operational_and_In_Pipeline_Plants_in_Andhra_Pradesh_and_Tamil_Nadu

[11] https://indiaclimatedialogue.net/2019/05/17/photo-feature-coping-with-a-stressed-cauvery/

[12] https://www.cag.org.in/sites/default/files/database/coal_power_plants_in_tn-_a_decade_of_false_starts_and_falling_performances.pdf

[13] https://shaktifoundation.in/wp-content/uploads/2017/09/State-of-CSP-in-India.pdf

[14] https://www.sciencedirect.com/science/article/pii/S1876610215005135/pdfft?isDTMRedir=true&download=true

[15] https://academic.oup.com/ce/article-pdf/2/1/1/25132271/zky004.pdf

[16] https://www.saurenergy.com/solar-energy-news/tamil-nadu-planning-to-bid-out-250-mw-floating-solar-projects

[17] http://aquaticcommons.org/9512/1/na_2285.pdf

- Install Rooftop Solar Photovoltaic (RTPV) to its overall potential of 242 MW operates with a CUF of 20% in Salem district as per Rooftop Revolution Report in 2018.

The installed capacity of MTPS would reduce to 600 MW after the retirement of MTPS I. However, it can be enhanced to 964 MW from the above recommended measures (see Annexure II). Further, an expansion of the Floating solar plant by TANGEDCO on 14,690 ha[18] of water spread area of stanley reservoir of Mettur Dam [19] -in line with Tamil Nadu Solar Policy in 2019- can highly contribute to achieving the target installation of 9,000 MW solar capacity in Tamil Nadu by 2023. Also, it contributes to water conservation by reduction in evaporation from the reservoir[20] and will eventually fill up the post-decommissioning gap of 477 MW power generation in the Mettur thermal power plant.

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Written by Aakanksha Tiwari, Researcher- Environment and Climate Action

Tags: Coal; Energy demand; Cauvery river; Water crisis; Decommissioning of thermal power plant

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