

# AEEE Note on Mumbai Power Outage

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## About AEEE

Alliance for an Energy Efficient Economy (AEEE), is one of the leading organizations in India that works on creating awareness about energy efficiency as a resource. It is a policy advocacy and energy efficiency market enabler with a not-for-profit motive. We advocate for data-driven and evidence-based energy efficiency policies and research.

We foster a culture of energy efficiency in India, working with industry, government and civil society organizations. AEEE advocates for Thermal Comfort for All, and a Lean-Mean-Green philosophy to design and construct net-zero energy-water-waste built environments, Sustainable Transportation and robust Energy Data Framework for better policy-making and implementation, to build a culture of energy efficiency in India. We are committed to achieve India's energy transition for a climate-resilient and energy secure future and meet India's commitments to the 2030 nationally determined goals (NDC) and UN sustainable development goals (SDG).

# Introduction

On Oct 12, 2020, Mumbai witnessed a grid failure due to a major power outage in which the Maharashtra State Demand dropped down by 2.3 Giga Watt (GW). The Maharashtra State Demand was 17.3 GW on Oct 11, 2020 and due to the grid failure demand dropped to 15 GW as shown in Figure 1. The power outage caused railway lines and metro to suspend their operations, traffic signals to go down resulting in a severe jam, affecting businesses across the city.

There are multiple contributing factors to the grid failure but one of the major reasons that led to this failure was the inability to manage the increasing demand and the overloading of the remaining healthy transmission line.

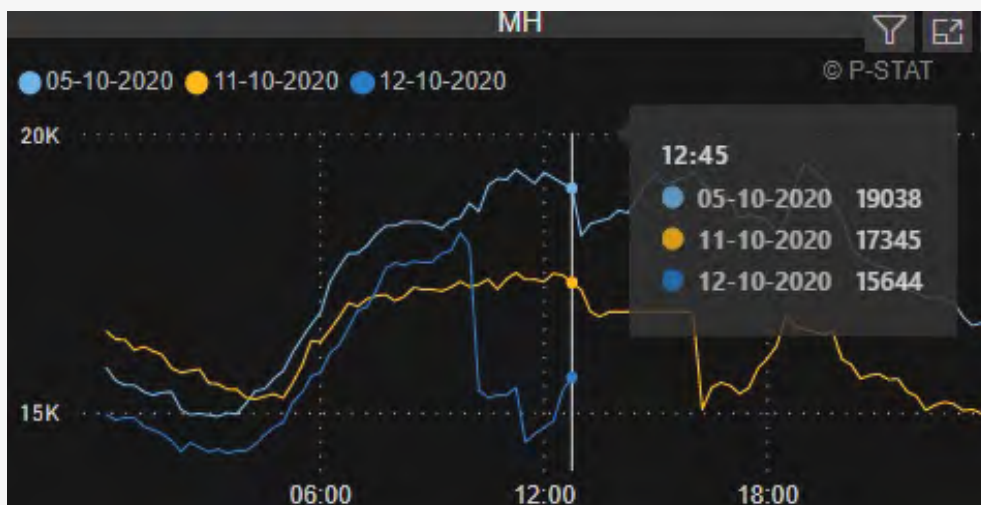
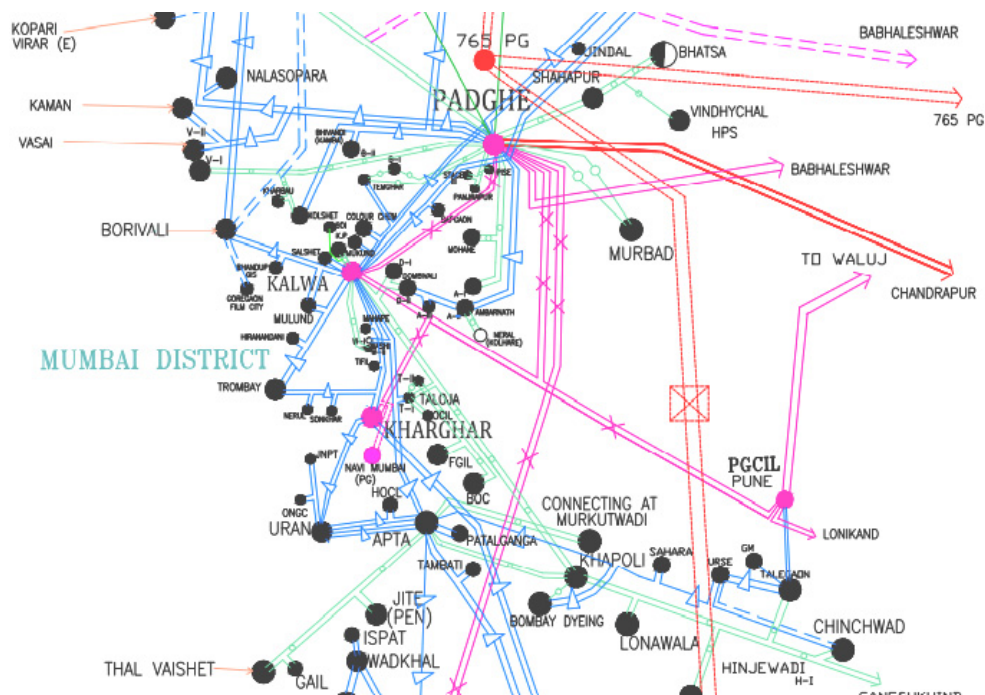


Figure 1: Snap shot of Maharashtra Load Curve

Source: [EMA Solutions](#)

## Background

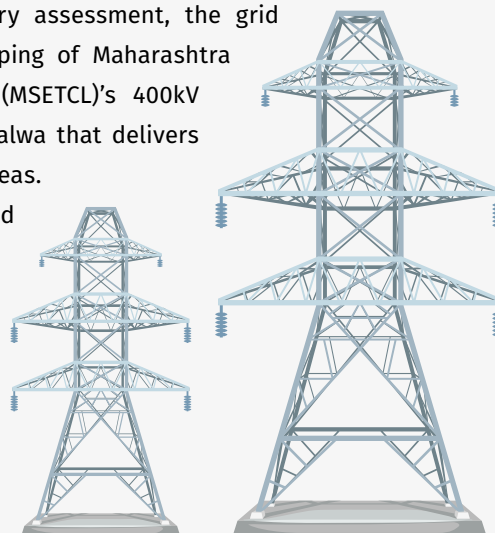
1. Three leading power distributors distribute power to Mumbai-Tata Power, Adani Electricity, and Brihanmumbai Electric Supply and Transport (BEST). Maharashtra State Electricity Distribution Co. Ltd (MSEDCL), the state-owned distributor, only supplies to a few pockets in the peripheral areas. The area supplied under Tata Power was the most affected in the blackout, with a reported load loss of 2600 MW.
2. Mumbai fulfils its power demand from the substations located at Salsette, Kalwa, Borivali, Vikhroli, Kharghar, and Versova. Maharashtra State Electricity Transmission Co. Ltd (MSETCL) delivers power to these substations. The unique islanding system available in Mumbai (and Kolkata) has always saved the city from grid disturbances. In such emergency cases, the city of Mumbai fulfils its demand through local generation sources. For Tata Power, this demand is met by its thermal plant located in Trombay and its Hydropower units located in Khopoli, Bhira, and Bhivpuri (in Pune district). For Adani Electricity, this demand is met through its unit in Dahanu. For both the distributors, the Kalwa substation is an integral part of the supply of electricity.

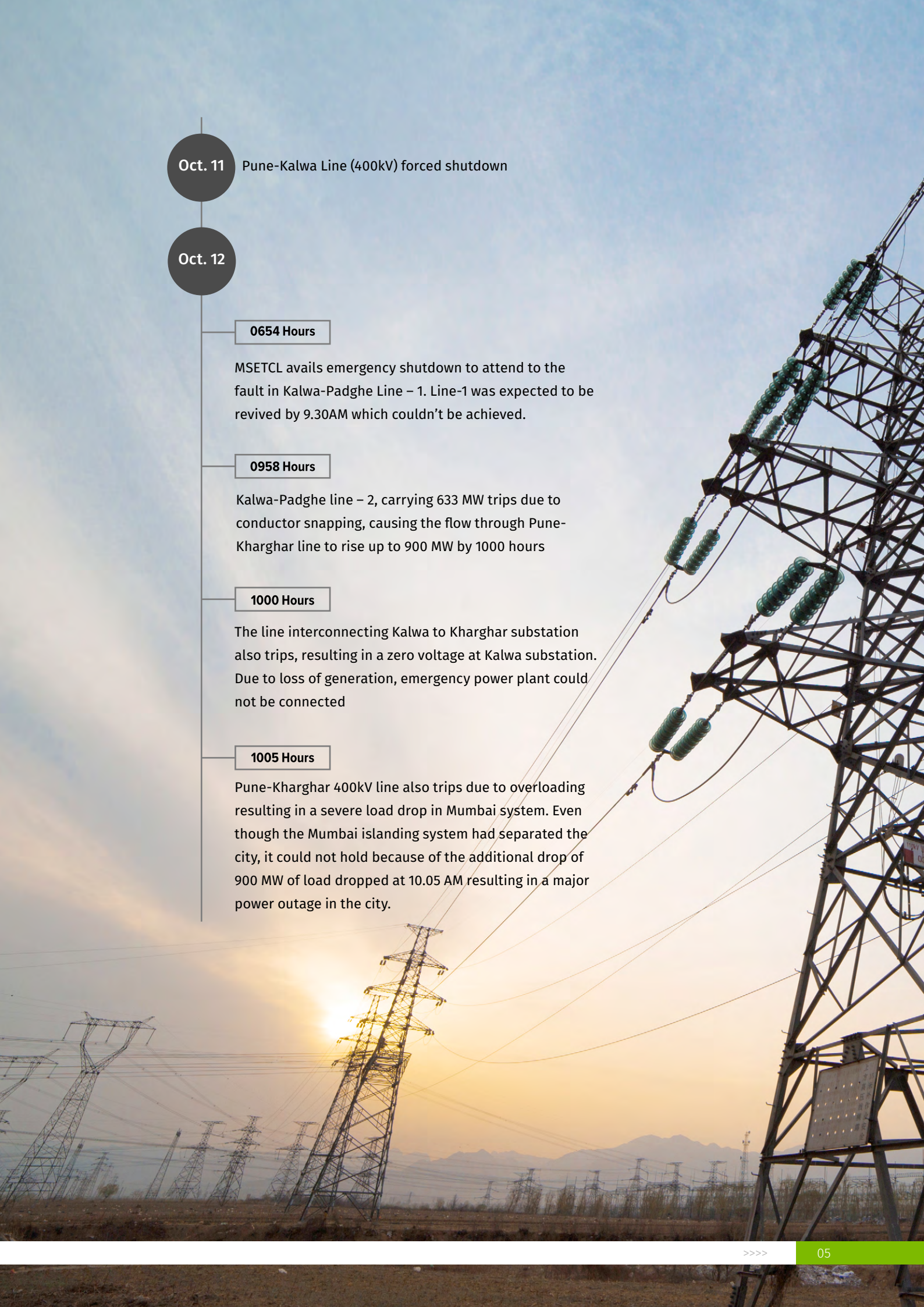


## Events that led to the grid failure

According to the Tata Power's preliminary assessment, the grid failure started at 10 AM due to the tripping of Maharashtra State Electricity Transmission Company (MSETCL)'s 400kV transmission line connecting Padghe to Kalwa that delivers the power to Mumbai and its adjoining areas.

There are two transmission lines; one had tripped early morning due to a fault and was under maintenance. The grid failure started when the second transmission line also failed. Now, the entirety of the demand was needed to be met through the remaining transmission system, which got overloaded and tripped, leading to the city's power outage.





**Oct. 11** Pune-Kalwa Line (400kV) forced shutdown

**Oct. 12**

**0654 Hours**

MSETCL avails emergency shutdown to attend to the fault in Kalwa-Padghe Line – 1. Line-1 was expected to be revived by 9.30AM which couldn't be achieved.

**0958 Hours**

Kalwa-Padghe line – 2, carrying 633 MW trips due to conductor snapping, causing the flow through Pune-Kharghar line to rise up to 900 MW by 1000 hours

**1000 Hours**

The line interconnecting Kalwa to Kharghar substation also trips, resulting in a zero voltage at Kalwa substation. Due to loss of generation, emergency power plant could not be connected

**1005 Hours**

Pune-Kharghar 400kV line also trips due to overloading resulting in a severe load drop in Mumbai system. Even though the Mumbai islanding system had separated the city, it could not hold because of the additional drop of 900 MW of load dropped at 10.05 AM resulting in a major power outage in the city.

**According to the flash report by WRLDC (POSOCO, 12.10.2020), the total load loss experienced across Mumbai was about 2600 MW while the total generation loss was around 840 MW.**

| Location | Generation Loss |
|----------|-----------------|
| Uran     | 220 MW          |
| Trombay  | 450 MW          |
| Dahanu   | 170 MW          |

Generation Loss

## Preexisting Problems

Accounts of prior power disturbances (2010) in Mumbai Metropolitan Region (MMR) and South Mumbai have been well studied and considering the disturbances, the Maharashtra Electricity Regulatory Commission (MERC) had specifically appointed a committee to review the existing power supply position in MMR, including its planning to provide for adequate capacity in terms of generation and transmission for future needs. Existing transmission lines delivering power to Mumbai are critically loaded, hence thrust was put upon setting up additional transmission lines and receiving stations in the Vikhroli project (Maharashtra Electricity Regulatory Commission, 2019).

The sub-transmission network was highlighted as the weak point in the Mumbai Distribution system. The MERC had granted the following to improve the sub-transmission network to Tata Power:

- » Establishment of 400 kV GIS Receiving Station at Vikhroli (Approval Date: 2 June 2011).
- » Construction of 400 kV Multi-Circuit Kharghar-Vikhroli Transmission Line and Bays (Approval Date: 20 October 2015).
- » DPR of Line In Line Out of 400 kV Talegaon-Kalwa Line at 400kV Vikhroli Receiving Station (Approval Date: 10 November 2017).

The commission had approved the 400kV Vikhroli Project from time to time for various components to meet the demand levels and augment the Available Transfer Capacity (ATC), but there had been an delays in the completion of the project.

- » However, on 12.09.18, the commission (MERC) had directed Tata Power to close down its 400kV Vikhroli Transmission scheme as STU (MSETCL) had observed delays in the completion of the said scheme.
- » On 02.01.19, Tata Power Co. – Transmission (TPC-T) filed a petition, seeking permission of the commission to continue the execution of 400kV Vikhroli Receiving Station and associated 400kV Transmission Line for strengthening of the Mumbai Transmission system.

STU was directed to submit its recommendations regarding the execution of 400kV Vikhroli Transmission Project under Tariff-Based Competitive Bidding (TBCB). It was directed to set up a credible mechanism for monitoring the project to ensure no further delays happen.

## Comments

- » There is no doubt that the power outage event of 12th Oct'20 had left Mumbai in complete chaos. The outage happened typically when the demand starts to increase due to the commercial and industrial sectors. However, it is possible that because of the Covid-19 situation, the increase was lesser but still significant.
- » Among the many reasons behind the power outage that are not clarified yet, the most significant ones could be overloading of transmission lines, outdated transmission infrastructure, lack of maintenance, and bad relay coordination.
- » There is a dire need to augment the existing transmission infrastructure as Mumbai's demand is bound to increase significantly. But the process was in delay.
- » However, network capacity addition is no easy process, and it requires substantial capital investments and right of way and labor costs. It is possible to optimize the cost of network capacity addition with the support of demand-side measures
- » The utilities in the future can adopt demand-side measures as part of their planning process and utilize tools such as emergency Demand Response Programs to ensure a reliable and secure flow of power, thereby avoiding such extreme blackout situations in the future. This will also help in building resilient systems, which can bounce back to operation after a disturbance.
- » As of today, no significant DR programs exist except for a few pilot programs, and the value proposition of DR for emergency management is unexplored.

## References

Maharashtra Electricity Regulatory Commission. (2019). *Case of Tata Power Co. Ltd. Seeking permission to continue execution 400kV of Vikhroli Receiving Station along with associated incoming of 400kV lines for strengthening of Mumbai Transmission System.* Mumbai: MERC, Case No. 3 of 2019.

POSOCO. (12.10.2020). *POSOCO WRLDC Flash Report.* POSOCO.



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