



*and Scheduling of Wind and Solar Generating Stations at the State level alternatively;*

*d) To initiate consultative process for framing of appropriate regulations for Forecasting and Scheduling for the wind and solar power at Intra State level in Maharashtra;...”*

3. The Petition states as follows:

1) MSEDCL is a Distribution Licensee under the provisions of the Electricity Act (EA), 2003 licensed to supply electricity in Maharashtra except some parts of the city of Mumbai. Regulation 12 of the RE Tariff Regulations, 2015 specifies the despatch principles for electricity generated from RE Sources. Under Regulation 12.1, all the RE Power Projects, except for Biomass-based and Co-Generation Projects, are treated as ‘must run’ and are not be subjected to Merit Order Despatch (MOD) principles:

*“12.1 Subject to the provisions of the Indian Electricity Grid Code and the State Electricity Grid Code, all RE Power Projects, except for Biomass-based Power Projects and Co-Generation Project, shall be treated as ‘Must Run’ Projects and shall not be subjected to ‘merit order despatch’ principles.*

*12.2 The Biomass-based Power Projects and Co-Generation Projects shall be subject to the scheduling and despatch code as specified under the State Grid Code:*

*Provided that, in case any other scheduling provisions for RE Projects are made by the appropriate authorities, these may be applied to the RE Projects in the State by the Commission by general or specific Order.”*

2) The National Tariff Policy provides that the Appropriate Commission shall fix a minimum percentage of the total consumption of electricity in the area of a Distribution Licensee for purchase of energy from RE sources, taking into account availability of such sources and its impact on retail tariffs. The Commission has notified the MERC (Renewable Purchase Obligation (RPO), its compliance and implementation of Renewable Energy Certificate (REC) Framework) Regulations, 2016 (‘RPO Regulations’) on 30 March, 2016, with higher RPO targets to be achieved by FY 2019-20:

Year	Quantum of Purchase of (in %) from renewable energy sources (in terms of the energy equivalent in kWh)		
	Solar	Non-Solar	Total
2016-17	1.00%	10.00%	11.00%
2017-18	2.00%	10.50%	12.50%
2018-19	2.75%	11.00%	13.75%
2019-20	3.50%	11.50%	15.00%

3) Maharashtra, with an installed RE capacity of 6705.15 MW (as on 31 March, 2015 (source: MEDA)) is second only to Tamil Nadu (9548.87 MW as on 08 February, 2016). The combined installed capacity of Wind and Solar in Maharashtra is 4770.96 MW. The Ministry of New and Renewable Energy (MNRE), Govt. of India (GoI) has predicted future RE installation of 22045 MW (7600 MW Wind and 11926 MW Solar) in Maharashtra, which is in line with the GoI's ambitious target of 175 GW of RE capacity to be achieved by the year 2022.

4) In view of the above, several States have accelerated the pace of RE installation, as seen from the recent increase in variable Wind and Solar power generation and future projections of higher share of RE in the total generation portfolio. In view of these developments, the associated challenges of Grid management and RE power procurement scheduling make Wind and Solar power forecasting essential for the system. Better forecasting helps grid operators more efficiently operate generators to accommodate changes in Wind and Solar generation and prepare for extreme events in which RE generation is unusually high or low. Forecasting and scheduling will not only drive operational efficiency but also help in cost savings. Short-term forecasts can be used to determine the need for a quick-start generator, demand response, or other mitigating options and thus drive reliability.

5) Optimum utilisation of existing Power Purchase Agreements (PPA):

a) Considering the future requirements, MSEDCL has tied up sufficient conventional power with approval of the Commission by taking into account the overall growth in the State. GoI's ambitious plan of RE capacity addition has accelerated the capacity addition from RE sources. Considering this expected capacity addition, it will be a challenge to balance the generation from already tied up thermal capacity and RE sources economically. MSEDCL is already in a surplus power position and backing down or running the thermal plants at technical minimum capacity. This is adding an additional burden of fixed cost affecting the viability and sustainability of operations of MSEDCL.

b) Considering the substantial component of fixed cost burden and expected RE capacity addition, optimum utilization of available generating sources will be essential for MSEDCL. It will require the flexibility to optimally utilize the conventional as well as RE sources. Flexibility refers to the ability of a power system to respond to changes in demand and supply. The requirement of increased generation flexibility is one of the major challenges posed by intermittent RE generation. Increase in variable generation in a system increases the variability of the generation from conventional plants. Due to the differences in design and technology, different types of Power Plants have different levels of operational flexibility, implying varying impacts on operation of the Plants and correspondingly on the Distribution Licensees. Considering the intermittent generation from increased RE capacity, it is important for the power purchase planning process to consider not only the adequacy of capacity to meet the

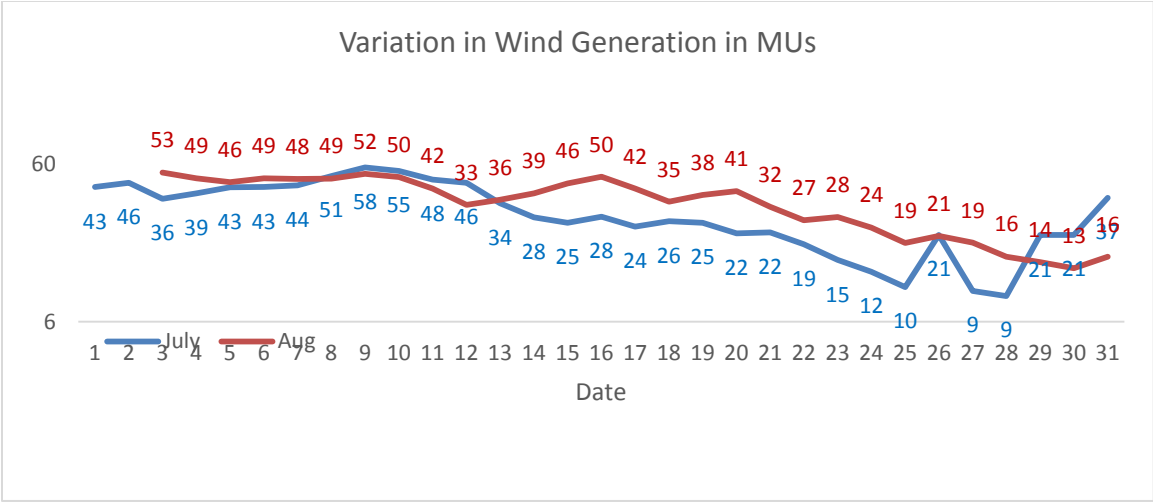
demand, but also the adequacy of generation flexibility. This would necessitate requisite Regulations for forecasting and scheduling so as to enable MSEDCL to undertake power planning.

c) In the absence of such Regulations, MSEDCL is facing difficulties in power purchase planning and scheduling. RE power being variable in nature makes optimum utilization of tied up thermal capacity difficult. Due to variable generation from RE sources, requisite balancing power from conventional sources is required as reserve to ensure that demand at any time is fully met. This is adding to costs and thereby the tariffs of end consumers.

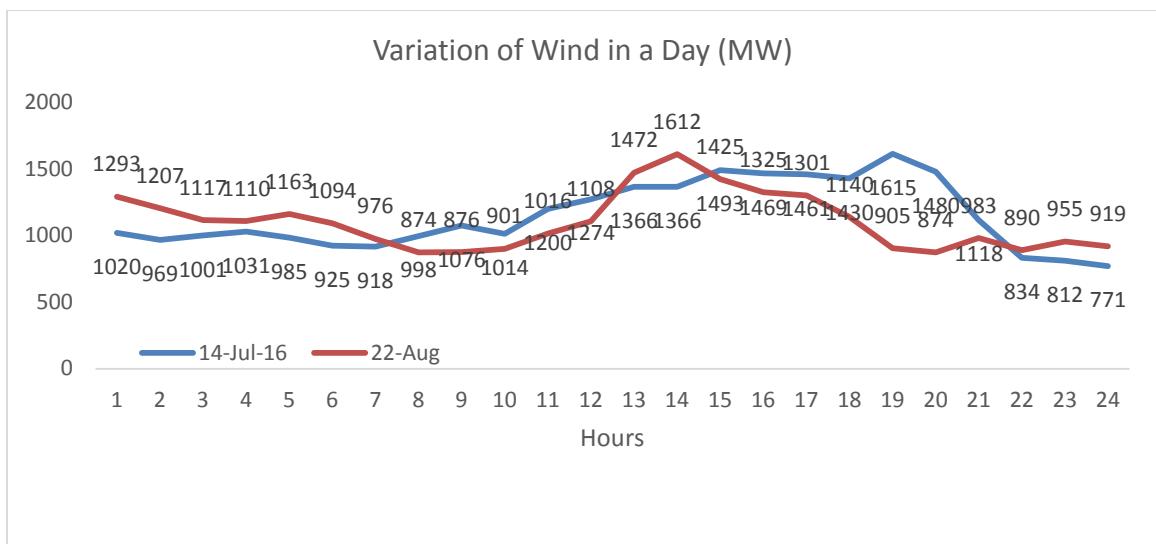
6) Scheduling:

a) MSEDCL is one of the largest Distribution Licensees in India in terms of energy consumption. During FY 2015-16, its peak demand varied from 16000 MW to 18000 MW. Further, there is huge variation in the demand (according to hours of the day as well as on monthly basis). Considering these variations, MSEDCL plans its power schedule. However, the infirm nature of Wind Power makes the power planning more and more difficult.

b) Electricity generated from Wind power is highly variable at several different times: hourly, daily, or seasonally. Because instantaneous electricity generation and consumption must remain in balance to maintain grid stability, this variability can present challenges to incorporating large amounts of Wind power into a grid. The following chart shows the variation in Wind Power in July and August, 2016:



Further, there is a huge variation in the daily generation as well. With such variability, it is difficult to plan the power procurement diligently. For the purpose of representation, 2 days' generation for 24 hours is shown in the following chart:



c) Wind and Solar power forecasts for the short term tend to be more accurate than forecasts for longer terms. To incorporate provisions for frequency of revisions for day-ahead scheduling, the higher the limit of frequency of revisions, the lesser will be the forecast error. The Model Regulations suggested by the Forum of Regulators (FOR) to the State Commissions state as follows:

*“Once the day-ahead schedule is submitted, flexibility must be accorded to the QCA (or generators) to revise it as the accuracy of forecasting improves closer to real-time. Keeping this in mind, 16 revisions per day have been allowed, to provide maximum opportunity to minimize deviations from schedule...”*

d) In view of the above, higher frequency of revisions would result in a considerable reduction in the forecast error, and the over-drawal/ under-drawal of electricity would fall within the limits specified in the Deviation Settlement Mechanism.

7) Forecasting:

a) Forecasting is an estimation of probable generation attempting to cope with the uncertainty of the future, relying mainly on data from the past and present and analysis of trends. The ‘Procedure for implementation of the framework on Forecasting, Scheduling and imbalance handling for RE Generating Stations including power parks based on Wind and Solar at inter-State level’ set out by the Central Electricity Regulatory Commission (CERC) provides that

*“Regional forecasting shall be done by the concerned RLDC to facilitate secure grid operation. The concerned RLDC may engage a forecasting agency to undertake forecasting for RE Generators/solar parks /wind parks which are regional entities.*

*RE generator shall provide the forecast to the concerned RLDC which may be based on their own forecast or RLDC’s forecast.”*

b) Thus, the primary objective of forecasting of Wind and Solar power is to ensure secure grid operation by planning for the requisite balancing resources. In line with the above provision, the forecasting for Wind and Solar generators connected to the State grid must be made mandatory for secure grid operations.

8) Grid Security:

a) Because of higher penetration of variable Wind and Solar resources, the energy mix will gradually shift towards higher share of RE. In order to facilitate large scale integration of RE which is infirm in nature and without compromising on the grid stability, reliability and security as envisaged under the Grid Code, appropriate guidelines/ Regulations are the need of the hour to ensure proper grid discipline and smooth functioning of various stakeholders in the system.

b) According to Regulations 2 (m) (i) and 7 (1) of the CERC (Deviation Settlement Mechanism and related matters) (Third Amendment) Regulations, 2016, the deviation limit for a RE-rich State has been set at 250 MW per time block:

*“..7 Limits on Deviation volume and consequences of crossing limits*

*(1) The overdrawal/ underdrawal of electricity by any buyer (except Renewable Rich States) during the time block shall not exceed 12% of its scheduled drawal or 150 MW, whichever is lower, when grid frequency is “49.70 Hz and above and below 50.10 Hz.*

*Provided that over-drawal/under-drawal of electricity by any Renewable Rich State during the time block shall not exceed limits as specified in Annexure-III, when grid frequency is “49.70 Hz and above and below 50.10 Hz.*

*Provided that no overdrawal of electricity by any buyer shall be permissible when grid frequency is “below 49.70 Hz” and no underdrawal of electricity by any buyer shall be permissible when grid frequency is “50.10 Hz and above”.*

*Annexure – III Deviation Limits for Renewable Rich States*

<i>Sr. No.</i>	<i>States having combined installed capacity of Wind and Solar projects</i>	<i>Deviation Limits (MW) - "L"</i>
<i>1.</i>	<i>1000-3000MW</i>	<i>200</i>
<i>2.</i>	<i>&gt;3000MW</i>	<i>250</i>

*...”*

c) Increasing share of RE power in the electricity generation mix and increasing deviation limits, grid discipline and security also need to be ensured by way of monitoring and scheduling the RE power being fed into the grid. As Wind and Solar generation enjoy ‘must run’ status under Regulation 5.2 (u) of the CERC (Indian Electricity Grid Code) Regulations, 2010 (‘IEGC’),

*“System operator (SLDC/ RLDC) shall make all efforts to evacuate the available solar and wind power and treat as a must-run station...”*

d) The RE Tariff Regulations, 2015 provides that all RE sources except for Biomass-based Power and Co-Generation Projects the status of ‘must run’. In view of the above, large scale induction of RE power into the system will attract counter measures from the Load Despatch Centre to balance the RE power injected into the grid and, accordingly, certain generators will be asked to back down. In case of a huge quantum of energy from RE sources being fed into the grid, it will be nearly impossible to back down such a large quantum of scheduled conventional/ hydro energy. It may not be feasible technically and may result in temporary shutdown of conventional power generators.

e) The Commission has issued Orders on Final Balancing and Settlement Code for Intra-State Availability-based Tariff (ABT) in Maharashtra for maintaining discipline with regard to the supply and drawal of energy by the State Pool Participants (SPPs):.

*“(xi) Accordingly with an objective of governing the functioning of the State Pool Participants in a way that discipline is maintained with regard to the supply and drawal of energy by the State Pool Participants and the reliability and integrity of power system is maintained, the Commission vide this order is notifying the ‘Balancing and Settlement Code’ for the Final Balancing and settlement mechanism.”*

9) This Final Balancing and Settlement Mechanism (FBSM) monitors intra-State transactions within Maharashtra. However, the existing FBSM has no specific provisions for scheduling of Wind and Solar Power generators. Therefore, considering the difficulties faced by MSEDCL, suitable guidelines may be provided for scheduling and forecasting of Wind and Solar Power. Alternatively, the Commission may issue separate Regulations for Forecasting and Scheduling of Wind and Solar power at the State level in line with the FOR Model Regulations.

10) In March, 2017, the CERC has issued the ‘Procedure for implementation of the framework on Forecasting, Scheduling and Imbalance Handling for RE Generating Stations including Power Parks based on Wind and Solar at Inter-State level’ with a view to strengthen the RE forecasting, scheduling and balancing framework. The RE Generator has to provide day-ahead forecast, real-time availability and generation schedule. The RE Generator will also have to provide monthly data transfer at the turbine and inverter level. It will be responsible for metering and data collection, transmission and co-ordination and undertake commercial settlement of all deviation settlement charges as per the applicable CERC Regulations etc.

11) The concerned Regional Load Despatch Centre (RLDC) shall be responsible for forecasting, scheduling, communication, coordination with RE Generators. There are two alternatives suggested in the Framework for scheduling and despatch for Generators. One



is that the RLDC shall be responsible for scheduling, communication, coordination with RE Generators of 50 MW and above and connected to Inter-State Transmission System. The other is that the Generator shall be responsible for coordination and communication with the RLDC, the State Load Despatch Centres (SLDC), Regional Power Committees (RPC) and other agencies for scheduling of RE Generators individually having less than 50 MW, but collectively having an aggregate installed capacity of 50 MW and above and connected within the Solar Park. RPC shall be responsible for energy accounting. Further, procedures are laid down for the treatment of RECs, commercial settlement, application of losses and charges, RLDC fees and charges and removal of difficulties.

12) This procedure is to be followed by the National Load Despatch Centre (NLDC), all RLDCs, RPCs, and SLDCs, and regional entity Wind / Solar Generating Stations including Power Parks, Principal Generators and Lead Generators.

13) FOR – a body representing all the State Electricity Regulatory Commissions (SERCs) and chaired by CERC - published Model Regulations on Forecasting, Scheduling and Deviation Settlement of Wind and Solar Generating Stations at the State Level for intra-state RE deviation settlement covering all the Wind and Solar power generators connected to the State Grid. CERC and FOR have come up with these Regulations to facilitate large-scale grid integration of Solar and Wind Generating Stations, as envisaged by GoI's thrust on RE sources.

14) Karnataka Electricity Regulatory Commission (KERC) has notified the final Regulation on Wind/ Solar forecasting and scheduling, in line with FOR's Model Regulations on 31 May, 2016. Four other States, namely Tamil Nadu, Jharkhand, Rajasthan and Madhya Pradesh, have followed a similar path and have come out with draft Regulations in line with FOR's Model Regulations.

15) The FOR Model Regulations focus on:

- a) Mandatory forecasting and scheduling of all the existing and upcoming Wind/Solar power generation at the inter/intra-state level.
- b) Mandatory own parallel forecasting mechanism by RLDC/SLDC primarily to manage secure grid operations.
- c) Wind/Solar power producer can either choose to have his own forecast or opt for RLDC/SLDC's forecast for the scheduling purpose.
- d) The deviations arising due to a difference between the scheduled generation and actual generation will be settled as per the penalty mechanism adopted under the respective Regulations.
- e) Introduction of Qualified Coordinating Agency (QCA) which shall manage the entire exercise of forecasting, scheduling, energy metering, telemetry, deviation management, commercial settlement.

16) Most recently, CERC has published an Office Memorandum dated 10 April, 2017 on a proposal for establishment of Renewable Energy Management Centres (REMC).



This proposal aims at establishment of region-wise REMCs to address variability, intermittency and ramping aspects of RE integration through deployment of state-of-the-art monitoring, forecasting and scheduling systems. This will help the grid operator to effectively manage power system operations with economy, reliability and security. The main objectives of the REMC include:

- a) Forecasting of RE generation at different levels such as State/region aggregated, pooling station wise, etc. based on information from Forecast Service provider (FSP) as well as Weather Service Provider (WSP)
- b) RE Generation Scheduling
- c) Real-time tracking of generation of RE sources, integration with REMC SCADA and its visualization
- d) Close coordination with respective LDCs for RE generation and integration with existing SCADA.

17) In the view of the CERC Framework, 2017, the CERC proposal on establishment of REMC, 2017, FBSM and the FOR Model Regulations, 2015, the Commission may initiate the process of framing Regulations on Forecasting and Scheduling for the Wind and Solar power at the Intra-State level in Maharashtra.

18) Such Regulations on Scheduling and Forecasting would inculcate grid discipline amongst the RE generators. They would facilitate large-scale grid integration of Solar and Wind Generating Stations while maintaining grid stability and security as envisaged under the Grid Code, through forecasting, scheduling and commercial mechanism for deviation settlement.

19) It is essential to have information about how much RE power is expected to be injected into the grid. Such information is critical for infirm sources such as Wind and Solar. Forecasting and scheduling of generation from these sources is important for balancing requirements and to procure requisite reserves to maintain load-generation balance and grid reliability.

20) Therefore, the Commission may initiate the consultative process for framing such Regulations.

21) The Commission has Powers to issue Orders:

- a) The Commission has the powers to issue Regulations in the subject matter under Sections 86 (1) (e) and 181 of the EA, 2003 in the larger interest of the stakeholders in the system and promotion of RE:

#### *86. Functions of State Commission*

*(1) The State Commission shall discharge the following functions, namely: -  
...(e) promote co-generation and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale*

*of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licence; ...*

*...181. Powers of State Commissions to make regulations*

*(1) The State Commissions may, by notification, make regulations consistent with this Act and the rules generally to carry out the provisions of this Act.”*

b) Further, Regulation 82 of the RE Tariff Regulations, 2015 provides for removal of difficulties:

*“82. Power to remove difficulties*

*If any difficulty arises in giving effect to the provisions of these Regulations, the Commission may, by general or specific Order, make such provisions, not inconsistent with the provisions of the Act, as may appear to be necessary for removing the difficulty.”*

c) Thus, the Commission has sufficient powers to deal with the matter and issue Orders as deemed appropriate.

4. The proceedings of the hearing held on 3 August, 2017 are summarized as follows:

4.1 MSEDCL stated that:

(i) Regulation 12.1 of the RE Tariff Regulations, 2015 provides that all RE Power Projects, except for Biomass-based and Co-Generation Projects, be treated as ‘Must Run’ Projects and are not subject to MOD principles.

(ii) In order to achieve Govt. of India’s ambitious plan of setting up 175 GW of RE by 2022, States have accelerated the pace of RE capacity addition, particularly Wind and Solar energy, and RE generation will have a higher share in the total generation portfolio.

(iii) For operational efficiency, adequacy of generation flexibility and cost saving, forecasting and scheduling of infirm RE power is essential. MSEDCL is already in a surplus power position and has to back down Thermal Power Plants, which results in additional burden of fixed costs affecting the viability and sustainability of its operations.

(iv) In its Deviation Settlement Mechanism and related matters (Third Amendment) Regulations, 2016, CERC has set the deviation limit in a RE rich States at 250 MW per time block and the limit for overdrawal /underdrawal as not more than 12% or 150 MW, when grid frequency is in the range of 49.70 Hz to 50.10 Hz.

(v) On 3 March, 2017, CERC has issued the Procedure for implementation of the framework on Forecasting, Scheduling and Imbalance Handling for RE Generating Stations, including Power Parks based on Wind and Solar at Inter-State level with a view to strengthen the RE forecasting, scheduling and balancing framework. FOR has also published Model Regulations covering all the Wind and Solar Generators connected to the State Grid.

4.2 The Commission asked to what extent the FOR Model Regulations and scheduling of infirm power will really help a in 3-4 hour time span. MSEDCL responded that the infirm nature of Wind Power and its variation in a given period of time poses a challenge to maintaining grid stability and for power purchase planning. Forecasting and scheduling helps Grid operators operate Generators more efficiently to accommodate changes in Wind and Solar generation. Depending upon the generation, MSEDCL can plan in advance its resources so that the financial burden can be reduced.

4.3 MSEDCL stated that KERC has notified its Regulations, and four other States, viz. Tamil Nadu, Jharkhand, Rajasthan and Madhya Pradesh, have come out with draft Regulations in line with the FOR Model Regulations. In the proviso to Regulation 12.2 of the RE Tariff Regulations, 2015, the Commission has also provided for application of scheduling provisions to RE projects (other than Biomass based and Co-generation projects) by general or specific Order.

4.4 The Commission observed that it has already initiated the process of framing Regulations for forecasting and scheduling of Wind and Solar generation.

4.5 Dr. Ashok Pendse, on behalf of Thane-Belapur Industries Association (TBIA) (an authorized Consumer Representative), stated that implementation of the forecasting model is a big challenge. Germany is using a scheduling and forecasting model over the last 16 years but it has not exceeded 3 to 4% accuracy, that too in a small geographical area, considering the environmental impact. California has also achieved only 12 to 15% accuracy level. Also, availability of the transmission corridor is an issue for implementing of scheduling model.

### Commission's Ruling

5. **The Commission is aware of the issues arising from the large expansion expected in infirm Solar and Wind generation in Maharashtra, the FOR Model Regulations, and the exercises being undertaken in other States, all of which have been cited by MSEDCL. As mentioned at the hearing, the Commission is preparing draft Regulations for forecasting, scheduling and deviation settlement for Solar and Wind generation, and expects to publish them along with a Discussion Paper for public consultation shortly.**

The Petition of Maharashtra State Electricity Distribution Co. Ltd. in Case No.87 of 2017 stands disposed of accordingly.

Sd/-  
(Deepak Lad)  
Member

Sd/-  
(Azeez M. Khan)  
Member

  
(Ashwani Kumar Sinha)  
Secretary

