ग्रिड-इंडिया
GRID-INDIA

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(भारत सरकार का उद्यम)
GRID CONTROLLER OF INDIA LIMITED
(A Government of India Enterprise)
[formerly Power System Operation Corporation Limited (POSOCO)]
राष्ट्रीय भार प्रेषण केन्द्र / National Load Despatch Centre

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संदर्भ: GRID-INDIA/NLDC/CERC/ **दिनांक:** 10th August 2023

सेवा में,

सचिव,

केन्द्रीय विद्युत विनियामक आयोग

3rd एवं 4th फ्लोर, चंदरलोक बिल्डिंग

36, जनपथ, नयी दिल्ली, 110001

विषय: Approach Paper on Terms and Conditions of Tariff Regulations for the period 1st April 2024 to 31st March 2029 – suggestions thereof

महोदय/महोदया,

The suggestions on behalf of Regional Load Despatch Centres(RLDCs) and National Load Despatch Centre(NLDC) on the Approach Paper on Terms and Conditions of Tariff Regulations for the period 1st April 2024 to 31st March 2029 are enclosed herewith for kind perusal.

It is regretted that there has been some delay in sending suggestions and it is requested that the enclosed suggestions may kindly be considered while framing the draft regulation.

सधन्यवाद,

भवदीय,

(एस. सी. सक्सेना)
कार्यपालक-निदेशक-रा.भा.प्रे.कें.

Encl: As above

Copy for kind information:

1. CMD, Grid-India
2. All RLDC Heads

Suggestions on the Approach Paper on Terms and Conditions of Tariff Regulations for the period 1st April 2024 to 31st March 2029

Grid Controller of India Limited
(A Govt. of India Enterprise)
(Formerly Power System Operation Corporation Limited)

I. Background:

CEA studies suggest that thermal generation is going to play a pivotal role in the energy mix of the country in the near future. As per CEA Optimal Generation Mix by 2030 study report, Volume-2, 275 GW (35% of mix) of thermal generation is required to meet the demand in 2029-30. The CERC approach paper Terms & Conditions of Tariff 2024-29 has attempted to incentivize thermal generation through the route of tariff mechanism, so as to achieve the required generation capacity.

However, emphasis also needs to be given to the flexibility requirements, so that the generation capacity aligns with the grid requirements especially in view of large scale renewable energy integration into the grid.

Various operational aspects such as incentivization of ramping, startup time of generators, linking fuel stock with availability, use of old thermal generators as synchronous condenser, modalities for determining of tariff for energy storage devices like - Battery Energy Storage System (BESS), Pump storage etc. among others which are important from reliability considerations need to be included in the tariff regulation. Some of them have found mention in the earlier Terms and Conditions of Tariff Regulations and may be included for the next control period.

Further, there should be some provision for mandatory sale of un requisitioned surplus (URS) power in the market by the generators whose tariff is regulated by the Hon'ble Commission. In case of URS power available, the generators get fixed charges paid from the original beneficiaries and feel no obligation to offer the same in the market. Selling the URS power in the market will increase liquidity and result in better price discovery.

Grid-India's suggestions emphasize the aspects of grid security, reliability, flexibility, resilience and resource adequacy among other things.

II. Generation:

A. Need for incentivizing flexibility:

i. Ramping requirement -

As large scale RE will keep on integrating into the grid, the thermal fleet has to complement to the variability being introduced by RE into grid. The diurnal variation of demand has also increased steeply (Fig-1). This has culminated into high ramping requirement during morning and evening hours (Fig-2).

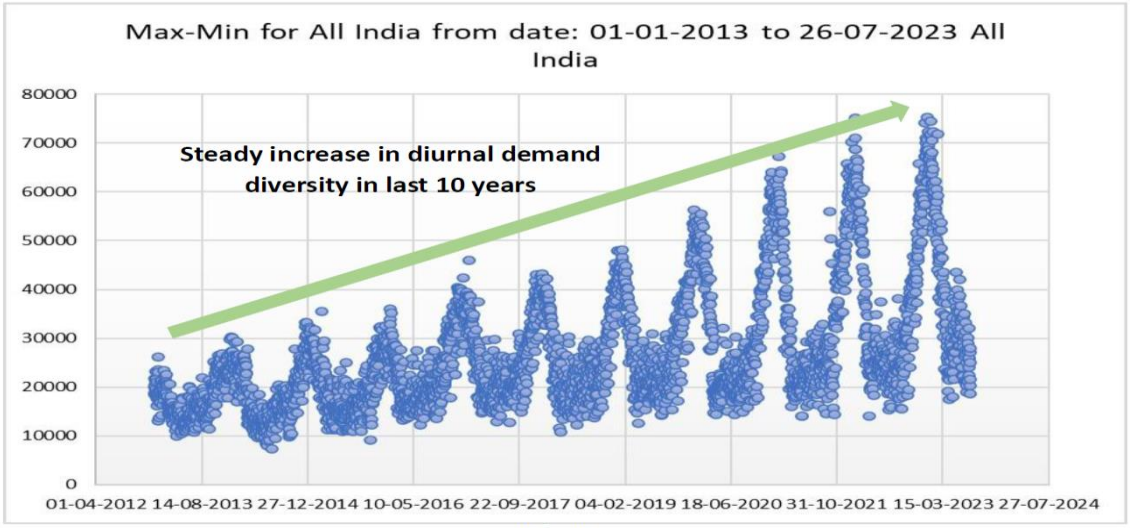
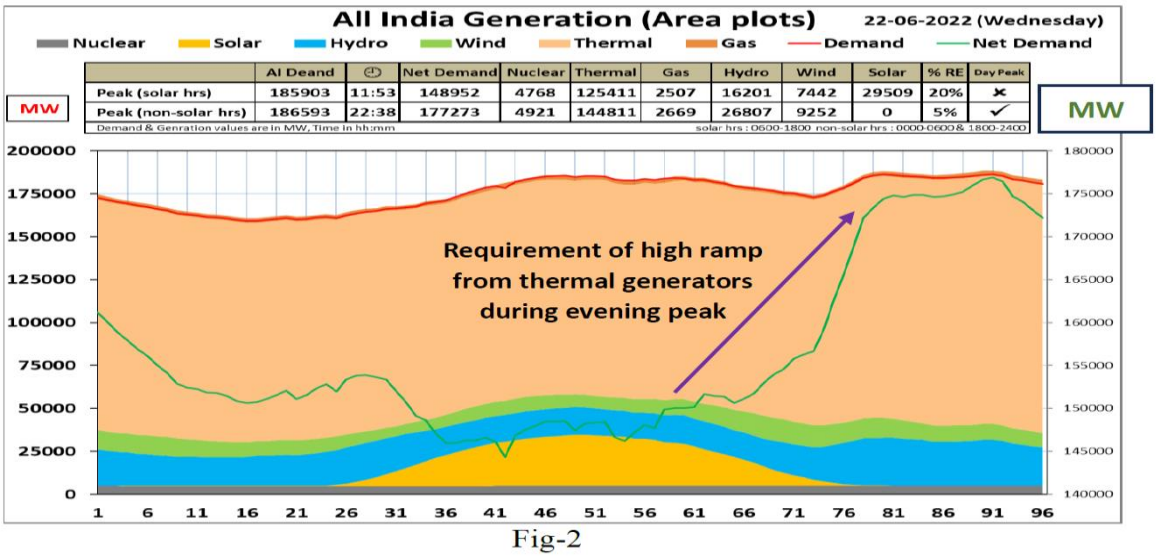


Fig-1



	Al Deand		Net Demand	Nuclear	Thermal	Gas	Hydro	Wind	Solar	% RE	Day Peak
Peak (solar hrs)	185903	11:53	148952	4768	125411	2507	16201	7442	29509	20%	✗
Peak (non-solar hrs)	186593	22:38	177273	4921	144811	2669	26807	9252	0	5%	✓

Demand & Genration values are in MW, Time in hh:mm
solar hrs : 0600-1800 non-solar hrs : 0000-0600& 1800-2400

Fig-2

Further, thermal flexibility is required for supporting the grid in case there is sharp changes in demand and/or generation. For instance, during the monsoon season, much of the coastal part of the country is prone to several depressions/cyclones formed in the Arabian Sea and Bay of Bengal. These depressions/cyclones along with its cloud cover not only impact the demand in the adjacent region but also create severe deviations in wind and solar generation on either side. Such events affect supply-demand balance in grid and require quick response in the form of fast ramping, taking units under RSD or bringing back units on bar from hot/warm/cold start as applicable.

In the Tariff Regulations 2019-24, the commission had introduced a minimum ramp rate of 1% per minute and incentivized higher ramp rates, as quoted below.

Quote:

30(2)(iii). In case of a thermal generating station, with effect from 1.4.2020:

a) rate of return on equity shall be reduced by 0.25% in case of failure to achieve the ramp rate of 1% per minute;

b) an additional rate of return on equity of 0.25% shall be allowed for every incremental ramp rate of 1% per minute achieved over and above the ramp rate of 1% per minute, subject to ceiling of additional rate of return on equity of 1.00%:

Un-Quote

The mandate of maintaining a minimum of 1% ramp rate, has facilitated increase in the ramping reserves available in the system. However, with further continuous increase in the RE integration levels, the ramping requirements of the system would further increase.

The CEA **"Flexible Operation of Coal based Thermal Power Generating Units" Regulations 2023** (link: https://egazette.gov.in/WriteReadData/2023/243299.pdf) have mandated norms for ramp rates as reproduced below –

Quote :

7. Ramp rates capabilities of coal based thermal power generating units for flexible operation -

(1) The coal based thermal power generating units shall have ramp rate capability of minimum three percent per minute for their operation between seventy percent to hundred percent of maximum continuous power rating and shall have ramp rate capability of minimum two percent per minute for their operation between fifty-five percent to seventy percent of maximum continuous power rating. Provided that the generating units which are not capable to comply with this regulation, shall comply with the same within one year of the notification of these regulations.

(2) The coal based thermal power generating units shall achieve ramp rate capability of minimum one percent per minute for their operation between forty percent to fifty-five percent of maximum continuous power rating as per phasing plan mentioned in the sub-regulation (2) of regulation 5 of these regulations.

Unquote

Accordingly, the ramping requirement may be made as per the CEA standards, with suitable tariff mechanism to incentivize better ramping performance over and above the minimum benchmarks as defined by CEA.

ii. Running units below minimum turndown -

The CEA **"Flexible Operation of Coal based Thermal Power Generating Units" Regulations 2023** have mandated norms regarding minimum power level –

Quote:

6. Minimum power level capabilities of coal based thermal power generating units for flexible operation –

The coal based thermal power generating units shall have flexible operation capability with minimum power level of forty percent. Provided that the generating units which are not capable of achieving minimum power level of fifty-five percent, shall achieve the same within one year of the notification of these regulations.

Provided further that the generating units which are not capable of achieving minimum power level of forty percent, shall achieve the same as per phasing plan mentioned in the sub-regulation (2) of regulation 5 of these regulations.

Unquote

However, due to system requirements a unit may be required to run below its minimum power level. For instance, in the interest of grid security, in adverse weather conditions or maintaining of necessary grid inertia certain generating plants may require to be run below their minimum turndown level without going into reserve shutdown. To ensure such support from generators provision may be provided in the Tariff Regulation with suitable mechanism may be provided in the tariff regulation.

iii. Synchronous condenser mode operation for the old/retiring conventional power stations –

A synchronous condenser (SC) is a synchronous machine operating without a prime mover. Reactive power output regulation of SC is performed by regulating the excitation current. The level of excitation determines if the synchronous condenser generates or consumes reactive power. SC provides improved voltage regulation and stability by continuously generating/absorbing reactive power, improved short-circuit strength and frequency stability

by providing inertia. IEGC-2023, has mandated hydro and gas generating units having this capability to operate in synchronous condenser mode operation as per instructions of the RLDC or SLDC.

Quote –

> *(10) Hydro and gas generating units having this capability shall operate in synchronous condenser mode operation as per instructions of the RLDC or SLDC of the respective control area. Standalone synchronous condenser units shall operate as per the instructions of RLDC or SLDC, as per the respective control area. The compensation for such synchronous condenser mode operation shall be included in the procedure to be submitted by NLDC and approved by the Commission.*
>
> *Unquote.*

With the high penetration of renewable energy sources like wind and solar power and gradual reduction/decommissioning of conventional generators, total system inertia of grid would decline. However, synchronous condenser can provide fast response to arrest the frequency decline and help restore the frequency.

The Manual on Transmission Planning Criteria 2023 by CEA (Link: https://cea.nic.in/wp-content/uploads/psp a ii/2023/03/Manual on Transmission Planning Criteria 2023.pdf) mentions for use of conventional power stations as synchronous condenser.

Quote –

> *5.4.5.2 The conventional power stations could be refurbished to a synchronous condenser, thereby potentially reducing initial capital cost. A synchronous condenser consumes a small amount of active power from the system to cover losses. As many*

gas and coal-based synchronous generators approach the end of their life, the retiring of a plant can possibly create a reactive power deficit at the local network, which may impact voltage stability. The conversion of the existing generator to a synchronous condenser can be potentially economical and effective

Unquote.

Therefore, provisions in tariff regulation may be introduced for using old/retiring conventional power stations in synchronous condenser mode.

iv. Two-Shift operation –

CEA's 2019 report, **"Flexible operation of thermal power plants for integration of renewable generation"**(Link: https://cea.nic.in/old/reports/others/thermal/trm/flexible_operation.pdf) suggested to run 5000 MW out of 10000 MW old small size (151 MW or less) units for six hours in the evening peak hours for integration of generation from 175 GW RE source. Most of these units are more than 25 years old and have high Energy Charge Rate (ECR).

Two shift operation provides a solution towards keeping the old but efficient thermal units in service. 2023 CEA report titled **"Flexibilisation of Coal Fired Power Plants"** (link: https://cea.nic.in/wp-content/uploads/tprm/2023/03/Report_21022023.pdf) cites example of two shift operation of TANGEDCO, Tamil Nadu, where the two shift mode operation started in April 2022 and is being continued to accommodate the renewable generation as and when required. As per the report the units operated at full load during evening peak hours, operating for 16 hours in a day from 5pm to 11am, in hot startup mode. 210 MW units of TANGEDCO which are more than 30 years old are being operated in two shift mode. Out of the fleet, 3 nos. of units are of more than 40 years old. The report further mentions –

Quote:

Two-shift operation is a costly mode of operation because of lower PLF and accelerated equipment life consumption due to daily start stop and increased forced outages. In the Indian market context, it will make economic sense for the older plants (with near-zero fixed costs/fully depreciated capital costs) to be retrofitted for a two-shifting mode of operation. As these plants would be on bar for a limited duration, the overall emissions will be much lower, compared to the plants operating on lower loads for a longer duration.

The start-ups in daily two-shifting operations will mostly be hot start-ups, which are less damaging (equipment life consumption) than warm or cold start-ups. These plants are best placed, economically to deliver the peaking power (which can be opted as an Ancillary service product or suitable compensation mechanism to be installed). More study regarding startup optimization, minimization of equipment damage is required for two shift operation of thermal power plants.

Unquote

The tariff regulation may provide with suitable cost recovery mechanism as well as incentive structure to make two shift operation an attractive proposition for the old but efficient plants without the necessity of forcible retirement.

v. Sale of URS power in power market:

In case of low demand situation, un-requisitioned surplus (URS) is available with the thermal power plants. Also, some thermal power plants, including gas generating stations remain undespatched (part or full) due to high variable cost. These plants do not bid in the market for the URS quantum, as the fixed charge recovery is assured with 85% availability.

In the Tariff Regulation, provision may be included, so that these generators should be mandated to bid the URS power in the market at their variable cost failing which a percentage of fixed cost may be reduced. The sale of URS power in the market will increase liquidity and result in reduced pressure on prices.

Since we are moving towards more market based transactions, tariff design should encourage generators to participate actively in market for recovery of their costs.

B. Declaration of National Peak and Off-peak Period

Contribution from coal based thermal generation is in the range of 70-80% during All India peak demand. Therefore, for ensuring resource adequacy during All India peak demand season, it is desirable that the planned outage of thermal as well as nuclear units is kept minimum.

As of now, outages of thermal units are being planned based on the respective regional demand in line with clause 42(3) of Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019. Relevant excerpt are as follows:

Quote :

"The High Demand Season (period of three months, consecutive or otherwise) and Low Demand Season (period of remaining nine months, consecutive or otherwise) in a region shall be declared by the concerned RLDC, at least six months in advance."

Provided that RLDC, after duly considering the comments of the concerned stakeholders, shall declare Peak Hours and High Demand Season in such a way as to coincide with the

majority of the Peak Hours and High Demand Season of the region to the maximum extent possible:

Provided further that in respect of a generating station having beneficiaries across different regions, the High Demand Season and the Peak Hours shall correspond to the High Demand Season and Peak Hours of the region in which majority of its beneficiaries, in terms of percentage of allocation of share, are located."

Unquote

Thus, the current provisions require the Regional Load Despatch Centres (RLDCs) to notify in advance the months of high demand season and low demand season so as to facilitate higher availability of generators and optimise their maintenance shutdown planning at regional level. The generating stations need to maintain specified target availability against the regional peak hours/demand season as declared by RLDCs.

With increasing penetration of RE generation, particularly solar and shifting of agricultural load to high solar periods, the shape of the net load (demand less RE generation) has undergone changes in past years. With the increasing footprint of the Indian electricity grid and its extension to neighbouring countries, a 'regional' approach might be sub-optimal. Further, with synchronous interconnection of grids and a pan India electricity market, declaration peak at national level by NLDC merits consideration.

With increasing penetration of RE sources, it is desirable to consider net demand in place of peak demand while declaring peak demand months with due consideration of all India hydro generation and seasonality.

Availability of thermal units should be maximized to ensure resource adequacy to meet coincident all India demand. Planned outages of thermal units should be minimized during the months when coincident all India net demand met is highest.

A detailed note prepared by NLDC for determination of peak period for 2023-24 is attached for reference (Annexure-1).

It is hereby pertinent to mention that MoP has notified " Guidelines for Resource Adequacy Planning Framework for India" (link : https://static.pib.gov.in/WriteReadData/specificdocs/documents/2023/jun/doc2023628218801.pdf) on 28th June 2023, to ensure adequacy in generation capacity contracting such that demand is reliably met in future, in all the time horizons. The guidelines define Resource Adequacy as –

Quote –

> *"1.2. Resource Adequacy means tying up sufficient capacity to reliably serve expected demand of the consumers in the DISCOMs license area in a cost effective manner. Reliability is measured through the instances/probability of system peak exceeding the contracted capacity that is effectively available at a National/State level. The guidelines aim to establish a Resource Adequacy framework for power procurement by distribution licensees, ensuring a reliable operation of the power system across all timeframes. The Resource Adequacy exercise will assess the required capacity to be contracted on long term, medium term, and short-term basis. A key aspect of resource adequacy planning is to ensure that adequate generation capacities are available, round-the-clock, to reliably serve demand, under various scenarios. This translates into requirement of an adequate reserve to cater to varying levels of demand and supply conditions prevailing in the grid.*
>
> *Unquote.*

The guideline has mandated Central Electricity Authority to publish Long-term National Resource Adequacy Plan (LT-NRAP with planning horizon of 10 years on a rolling basis) and NLDC to annually publish a one-year look-ahead Short-term National Resource Adequacy Plan (ST-NRAP) (with one-year look-ahead window).

Quote –

3.2 NLDC shall annually publish a one-year look-ahead Short-term National Resource Adequacy Plan (ST-NRAP) which shall include parameters such as demand forecasts, resource availability based on under-construction status of new projects, planned maintenance schedules of existing stations, station-wise historic forced outage rates and decommissioning plans.

3.3 The hourly demand forecasts used by CEA and NLDC shall be aligned with the projections furnished by individual Distribution Licensees to CEA and NLDC. The STU / SLDC, on behalf of the distribution licensees in the State shall provide to CEA and NLDC by the month of May every year, the details regarding demand forecasts (peak and energy requirement) for the next 10 years, assessment of existing generation resources and such other details as may be required for the LT-NRAP and ST-NRAP.

……

The Distribution Licensee shall submit the details of the contracted capacities for the ensuing year for meeting RAR of national peak to the respective STU / SLDC after approval of respective SERC/JERC by the month of January. The STUs / SLDCs shall aggregate the total contracted capacities at the state level and submit the information to the respective RLDC. The RLDCs shall aggregate the capacities at the regional level and submit the information to the NLDC by the month of February. NLDC shall aggregate the capacities at the national level and check compliance with ST-NRAP and identify shortfall for the ensuing year, if any. In case of shortfall, NLDC shall either communicate the shortfall to

the SERC/JERC for compliance or facilitate a national-level auction for the balance capacity with participation from distribution licensees with capacity shortfall. The contracting for the balance capacity shortfall shall be completed by the month of March prior to the start of the delivery year (1st April). NLDC shall come out with a methodology to carry out national level auction for the procurement of the balance capacity.

Unquote.

As mentioned above to keep maximum availability of generation resources suitable provisions may be incorporated in Tariff Regulation for declaration of national level peak so as to ensure resource adequacy at national level.

C. Tariff Determination for Energy Storage Devices

The growth of renewable energy in India has been one of the key success stories of the nation's energy sector. Today, Solar and Wind power have become integral to the nation's energy mix along with the conventional energy sources with an objective to achieve 500 GW of non-fossil fuel generating resources by FY 2029-30.

The need of flexible resources to mitigate variability and intermittency while ensuring resource adequacy, energy storage becomes extremely important. Central Electricity Authority (CEA) in its **"Report on Optimal generation mix for the year 2030"** (Link : https://cea.nic.in/wp-content/uploads/irp/2023/05/Optimal_mix_report__2029_30_Version_2.0__For_Uploading.pdf) has projected that the non-fossil fuel based installed capacity (IC) by the end of 2029-30 is likely to be 500.6 GW, which will be about 64% of the total capacity mix. Energy storage capacity required for 2029-30 is likely to be 60.63 GW (18.98 GW Pump Storage Plant (PSP) and 41.65 GW Battery Energy Storage System (BESS) with storage of 336.4 GWh (128.15 GWh from PSP and 208.25 GWh from BESS). Keeping in view the circumstances, Energy Storage

System (ESS) becomes one of the key flexible sources of resource adequacy and grid balancing for the Indian power system.

The Regulation 3 (n) of the Central Electricity Regulatory Commission (Ancillary Services) Regulations, 2022 defines Energy Storage as –

Quote -

> *"3.n. "Energy Storage" in relation to the electricity system, means a facility where electrical energy is converted into any form of energy which can be stored, and subsequently reconverted into electrical energy;"*

Unquote

Commission may introduce suitable mechanism for tariff determination for the energy storage devices in Tariff Regulation.

D. Linking fuel stock with availability

Generators are allowed interest on working capital corresponding to different fuel stock circumstances. However, the availability calculations are based on day ahead availability which doesn't capture the on-site fuel stock position. It has been observed during real time operation that generators are declaring full availability for the day but not maintaining enough fuel stock as required under the regulations. This becomes evident during periods of continuous high demand where they are not able to generate on sustained basis up to the declared DC values. Instead, the generators revise the DC in such cases in accordance with the regulations. Keeping in mind the requirements of maintaining resource adequacy which stands for ensuring sufficient capacity to reliably serve expected demand of the consumers in cost effective manner in all time horizon, ensuring adequate fuel stock becomes necessary.

The above behaviour is within the regulations which specify the day ahead availability declaration and opportunity to revise the same in the course of the day. It raises a false sense of comfort on the generation availability front. The comfort turns into a surprise when the plant actually starts getting despatch and is unable to sustain the high generation level for the given period and reduces the declared availability.

Therefore, it is proposed that the availability of the generators may be reduced for not maintaining fuel stocks as per the norms.

A compliance code in line with IEGC-2023, may be introduced in Tariff Regulation for ensuring generator side compliance for fuel stock availability.

E. Review of Existing Norms with regard to linking recovery of fixed charges to the Plant Availability Factor

It has been observed that, in case of few stations of NTPC, some of the beneficiaries have surrendered their allocation of power from these stations on the basis of the GOI guidelines dated 22.03.2021 (Link : https://powermin.gov.in/sites/default/files/Enabling_the_Discoms_to_either_continue_or_exit_from_the_PPA.pdf). In light of this, it is pertinent to change the methodology for calculation of DC (%) in these stations.

Currently the practice of considering the full Installed Capacity is being followed in these stations, whereby in the denominator "Installed Capacity - APC" is being used to calculate the DC (%) of the station. As the recovery of Annual Fixed Cost would correspond to the Allocated Capacity only, considering the full Installed Capacity for calculation of DC (%) would

penalize the stations, as they would have to arrange fuel and incur some other costs which otherwise are not recoverable in AFC.

It is suggested that the DC of these stations should be calculated w.r.t the Allocated Capacity i.e. the Denominator should correspond to the Tied-up capacity (allocated capacity) of the station.

F. Startup time of generators:

Generator startup and shutdown time is an important parameter of flexibility. In times of weather related disturbances generators are often taken under reserved shutdown due to low demand. But as the effects of weather disturbance recedes demand in system quickly picks up requiring generators to swiftly return on bar. Any delay in this regard may lead to grid security issue while compromising grid resiliency.

Generators are providing the cold/warm/hot startup time in Format TRAS-I under CERC Ancillary Service Regulations-2022. Considering the large scale renewable integration in India, it is important that the generators coming out of cold reserve must be on bar in accordance with the declaration under format TRAS-I of Ancillary Service Regulations-2022. Failure to do so should attract penalty for the generators.

It is therefore proposed that necessary penal provisions such as reduction in availability for the past seven days may be introduced in the tariff regulations in case a plant fails to come on bar within declared startup time. Further an upper limit of start -up time for each category of generator may be provided in Tariff Regulation.

III. Transmission:

A. Operational Vs Deemed availability:

NLDC records the outage of elements under NLDC jurisdiction on monthly basis which simply calculates the time when element is under outage. The duration calculated in NLDC calculation gives an idea of time when element was actually available, however it has been observed that the final availability after approval from RPCs at times becomes much higher. Major transmission licensees, in its annual report mentions much higher availability than their actual physical availability, which makes licensee eligible for incentive apart from receiving fixed charge. The difference is on account of the relaxation provided under different heads. For reliable operation of the system, this difference needs to be minimized.

In 2019-24 regulations, provisions exist for complementing reliability. However, the provisions for excluding outage hours attributable to the transmission licensee give lot of scope for circumventing the provisions. The areas where scope of improvement is there are provided below:

a. **Construction Vs Operation & Maintenance (O&M) outage :** There are many areas which strictly fall in the category of O&M works but gets claimed under construction head e.g.
    - Replacement with polymer insulators, Controlled Switching Devices (CSD) relaycommissioning etc. should come under O&M Head instead of construction Head.
    - Element Outages due to modification work, like tower design strengthening and isolator & circuit breaker replacement for purpose of remote operation should come under O&M head.

- After declaration of commercial operation of new elements, elements are taken out for like tightening of nut, bolt and jumpers etc. in line should come under O&Mhead but claims being done under construction head.

b. Elements that need to be kept out to control high voltage: If a transmission line could not be revived after instruction of RLDC/NLDC on account of high voltage and line reactor of the same line is under outage then line may be considered unavailable for availability calculations. This will ensure the availability of line reactor and high voltage scenario willbe under check. Prolonged outage of line on high voltage impacts reliability and leads to substantial delay in charging of that element when code is issued in the real time. It is proposed that in case the licensee is not able to energize the line within one hour from the time of issuance of code by RLDC/NLDC then availability of that element would be considered zero for last seven days or actual number of days whichever is lower.

c. Generation Evacuation Lines: In the present regulations **"***in case of outage of a transmission element affecting evacuation of power from a generating station, outage hour shall be multiplied by a factor of 2"*. This may be extended to all cases of curtailment of Long Term Access (LTA)/Medium Term Open Access (MTOA) transactions. But in case of construction related outages, there is no impact on the transmission licensee. This aspect needs to be further made more stringent to cover construction related outages. Many a times the line under outage on account of construction related works are restored late and since no outage hour is attributed to them hence penalty increase by factor of 2also becomes immaterial.

d. DR/EL record provision: As per CEA Grid Standards "*All operational data, including disturbance recorder and event logger reports, for analysing the grid incidents and*

grid disturbance and any other data which in its view can be of help for analysing grid incidentor grid disturbance shall be furnished by the Entities within twenty four hours to the Regional Load Despatch Centre and concerned Regional Power Committee. Whether anytripping is attributable to licensee or not depends on event analysis outcome. Generally licensees include several tripping of lines due to over voltage or direct trip received fromfar end and by mentioning such reason, such type of outages get attributed to other agency. Further, spurious tripping can be identified only after confirming with DR/EL. In this regard it is suggested that onus will lie on transmission licensee to submit all operational data regarding disturbance on time. In case DR/EL is not received in time, the outage must be attributed to the licensee for availability calculations.

B. Requirement of additional provisions in the Terms and Conditions of Tariff Regulations:

In addition to existing provisions of 2024-29 regulations, there are certain sections which need to be added from reliability considerations and clear accountability. The sections to beadded are summarized below:

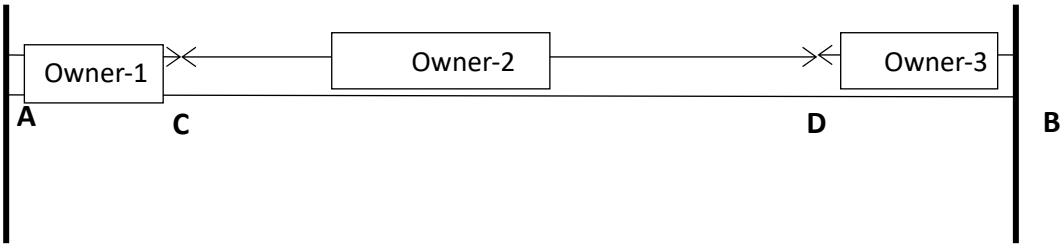
a. Lines owned by one transmission licensee and both end bays owned by other transmission licensee or STU

For many lines owned by transmission licensees, either one or both end bays are owned by other transmission licensee or STU. Any tripping of the lines due to protection maloperation or incorrect settings or Direct Trip (DT) received without fault, the outage is not attributable to licensee and claimed under other category. Therefore, the availability claimed for such lines are close to 100% and actual availability is much less than that. More than 2 tripping in a year (with additional 12 hours outage for each such tripping) must be attributed to the transmission licensee so that the maintenance and protection issues will be taken up regularly

with bay owner.

b. Multiple transmission licensees or equipment owners involved:

There has been an increase in Tariff Based Competitive Bidding (TBCB) lines and cases where bays are not owned by transmission licensee. Maintenance of such bays is done by substation owner as a deposit work and availability of bay owner as well as transmission licensee does notget affected much. The case may be illustrated by an example as given below:



Let us assume there is a line AB where different sections are owned by different players. Theyearly transmission charges of all three owners and yearly outage duration attributable to each section is tabulated below:

Sl.No.	Section	Owner	Outage hours
1	**AC**	Owner-1	**80**
2	**CD**	Owner-2	**80**
3	**DB**	Owner-3	**80**

Under present regulations, the section wise availability may be 99.08% which is incentivized in current regulations, however if we consider availability of complete line it may come out to be 97.26%. The system as a whole is impacted but the individual transmission licensees become eligible for incentive.

c. **No of trippings more than 2 in a year:** As per current regulations" additional 12 hours outage shall be considered in addition to the actual outage for more than 2 trippings in ayear". However, no such provision is there for HVDC system. In current scenario, when HVDC integration in the grid is increasing the same need to be enforced as part of the transmission availability calculation procedure.

d. **Notional breakup in case of HVDC:** With the operationalization of Multi-terminal HVDC systems, it is important that availability of DC line for different sections and HVDC terminals at different stations be factored separately so that multi-terminal operation flexibility is captured in the availability calculations.

e. **Timely restoration of outages:** The element taken out for O&M related works should bebrought back within scheduled time. Any delay from scheduled time shall double the outage hours and shall be attributed to transmission licensee. This will ensure the timely restoration of element and in-line with revised scheduled and ATC/TTC values.

f. **STATCOM availability:** In the Tariff Regulations 2019-24, STATCOM has been considered as a separate element for the first time which means that the availability of each STATCOM will be used while calculating the transmission availability of the regional transmission system. First time charging procedure for STATCOMs was issued by NLDC vide communication dated 19th April 2018 (Annexure-5). In this communication NLDC has clearly brought out the list of telemetry points and data to be reported from site to RLDC/NLDC control room in reference to STATCOM operation. However, all telemetered data in this regard are yet to be provided in some cases.

STATCOM being a dynamic VAR compensation device, provides fast reactive support to the grid during transient as well steady state operation. STATCOM has an additional feature of power oscillation damping which need tuning of its settings. In order to analyse the dynamic performance of STATCOM (STATCOM+ MSR /MSC) during day-to-day operation, installation of PMU for measuring the parameters of Coupling Transformer of the STATCOM is essential. In addition to PMUs, high resolution data of the period for faults where STATCOM should operate is also required to be provided by the transmission licensees. In absence of dynamic response data, it becomes difficult to analyse the performance or availability of STATCOM.

Thus, in order to determine the STATCOM performance, transmission licensee should be made responsible for furnishing PMU output at RLDC/NLDC. To analyse the dynamic performance of STATCOM, transmission licensee shall report the high resolution data of the period for faults where STATCOM should activate or as and when requested for by the RLDCs/NLDC. Failure to furnish data related to dynamic compensation by STATCOM should render it unavailable for the period since last operation.

In the calculation of availability of AC portion of Transmission System, STATCOM contribution appears missing. Suggested clause for TAFM modification is given below:

% TAFPn for AC system -

$$= \frac{[o \times AVo + p \times AVp + q \times AVq + r \times AVr + u \times AV_u]}{o + p + q + r + u} \times 100$$

U = Total number of STATCOMs ; AVu = Availability of u number of STATCOMs

g. **Factoring series compensation in transmission availability:** There is no mention of the Surge Impedance Loading (SIL) based weightage for transmission line. In the absence of SIL reference, FACT based series compensation devices will not be in radar for availability. In order to factor them under the availability, it is desired that Series/Shunt compensating devices may be defined as individual element with degree of compensation. This clause may be added in Procedure for Calculation of Transmission System Availability Factor for a Month.

h. **No risk approach:** It is observed that transmission licensees generally claim 'attributableto others' for tripping on account of lightning strokes, kite flying, farm fires, pollution related flashovers, storms etc. These are part of normal business risks that the transmission licensee should cover else it leads to an inflated value of availability which is misleading.

i. **Restoration time for Gas Insulated Substation (GIS)**: With commissioning of large number of GIS substations in the grid, it is necessary that restoration time post outage of switchyard elements is specifically mentioned in the terms and condition of tariff as well as the Performance Standards of Transmission Licensees.

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Annexure-1

GRID CONTROLLER OF INDIA LIMITED

(Formerly known as POWER SYSTEM OPERATION CORPORATION LIMITED)

NATIONAL LOAD DESPATCH CENTRE, NEW DELHI

15th Feb 2023

Subject: Inputs on declaration of all India peak and off-peak period in addition to regional peak and off-peak period.

A detailed note regarding methodology for declaration of all India peak has been shared on 07.02.23 and same is attached at **Annexe-I.**

Based on the findings, following are the key points:

a. It has been analyzed that requirement of thermal generation is high during the following months:
   - **April & May:** All India demand starts increasing on account of rise in temperature whereas hydro and wind generation remains low.
   - **September & October:** Hydro and wind generation starts declining while demand prevail on higher side.

b. Declaration of peak demand season and peak demand hours should also be from the All-India perspective in addition to regional perspective.

c. Regional peak months which are coinciding with national peak are as follows:
   - March is peak month for WR & SR whereas April is peak month of SR &ER.
   - In case of NR, peak months are June, July and August which are high hydro and Wind season months due to which thermal generation contribution will be less.
   - All India peak demand months satisfy the Western, Southern and Eastern regions to a large extent.

   Same is given at **Annexe-II.**

d. With increasing penetration of RE sources, it is desirable to consider net demand in place of peak demand while declaring peak demand months with due consideration of all India hydro generation and seasonality.

e. Availability of thermal units should be maximized to ensure resource adequacy to meet coincident all India demand. Planned outages of thermal units should be minimized during the months when coincident all India net demand met is highest.

f. In view of the above, it is prudent to declare all India peak demand period for thermal generators as follows:

   a. Four weeks (one month) in the period from April to May

b. Two weeks (half a month) in the period from September to October

g. Declaration of regional peak may be reviewed and time period would be reduced to two months instead of present three months.

h. Declaration of national peak period/season would be carried out by the end of preceding calendar year (31st Dec) for next financial year.

i. All India peak and off-peak hours would be declared on months ahead basis.

Annexe-I

GRID CONTROLLER OF INDIA LIMITED
NATIONAL LOAD DESPATCH CENTRE, NEW DELHI

07th Feb 2023

Subject: Inputs on modifying peak demand months for the purpose of tariff regulations
Background:

1. Contribution from coal based thermal generation is in the range of 70-80% during All India peak demand. Therefore, for ensuring resource adequacy during All India peak demand season, it is desirable that the planned outage of thermal as well as nuclear units is kept minimum.

2. As of now, outages of thermal units are being planned based on the respective regional demand in line with clause 42(3) of Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2019. Relevant excerpt are as follows:

   "The High Demand Season (period of three months, consecutive or otherwise) and Low Demand Season (period of remaining nine months, consecutive or otherwise) in a region shall be declared by the concerned RLDC, at least six months in advance."

   Provided that RLDC, after duly considering the comments of the concerned stakeholders, shall declare Peak Hours and High Demand Season in such a way as to coincide with the majority of the Peak Hours and High Demand Season of the region to the maximum extent possible:

   Provided further that in respect of a generating station having beneficiaries across different regions, the High Demand Season and the Peak Hours shall correspond to the High Demand Season and Peak Hours of the region in which majority of its beneficiaries, in terms of percentage of allocation of share, are located."

Table 1:Declared Region wise peak months for FY 2023-24

Northern Region	Western Region	Southern Region	Eastern Region	North Eastern Region
Jun-23	Dec-23	Apr-23	Apr-23	Jul-23
Jul-23	Jan-24	Feb-24	May-23	Aug-23
Aug-23	Mar-24	Mar-24	Jun-23	Sep-23

3. Coincident peak of all India demand

All India coincident Peak demand met and its occurrence time during 2018-23 is given in Table-2. All India coincident Peak Net demand met and its occurrence time during 2018-23 is give in Table-3.

Table 2: All India Peak demand and its occurrence

Gross Demand										
	2018-19		2019-20		2020-21*		2021-22		2022-23	
Month	Time	Peak demand met	Time	Peak demand met	Time	Peak demand met	Time	Peak demand met	Time	Peak demand met
Apr	19:45	161286	22:35	176810	22:20	132733	10:25	182379	14:50	207231
May	14:50	170765	15:00	182533	15:30	166225	11:50	168781	15:20	204382
Jun	21:25	170150	22:30	182454	22:20	164982	12:45	191243	14:45	211677
Jul	20:00	167798	21:10	175124	22:25	170408	12:00	200539	11:55	190215
Aug	19:55	170182	19:40	177525	19:55	167528	11:15	196146	12:10	195226
Sep	19:15	175528	19:20	173145	19:30	176413	11:45	180637	11:50	199341
Oct	19:00	170604	19:00	164259	18:55	169899	10:25	174427	19:15	186778
Nov	17:00	164108	18:25	155321	10:40	160779	18:25	166033	10:25	187346
Dec	9:45	162609	11:50	170492	9:45	182784	11:40	183249	10:45	205101
Jan	9:25	162349	9:25	170976	10:30	189395	11:25	192076	10:00	210725
Feb	9:35	161422	8:25	176388	9:45	188386	9:45	188386		
Mar	19:25	168745	9:25	170165	10:15	185892	11:00	199430		

*Apr-20 to Nov-20 and Apr-21- May-21 demand was affected due to COVID-19 lockdowns.

Table 3: All India Net demand met and its occurrence

Month	2018-19			2019-20			2020-21			2021-22			2022-23		
	Time	Max Net demand	% hydro in Net dmd	Time	Max Net demand	% hydro in Net dmd	Time	Max Net demand	% hydro in Net dmd	Time	Max Net demand	% hydro in Net dmd	Time	Max Net demand	% hydro in Net dmd
Apr	19:40	156538	10%	22:55	170149	14%	22:40	126533	18%	19:30	175751	15%	22:25	190832	14%
May	22:50	163903	13%	22:50	173398	13%	22:30	151679	19%	0:00	161609	10%	22:45	181951	15%
Jun	22:30	159482	16%	23:10	171898	15%	21:35	157470	20%	21:35	175402	19%	22:45	183854	16%
Jul	20:00	152661	18%	19:55	162962	17%	20:25	158900	21%	22:35	182379	19%	21:00	177784	22%
Aug	19:55	154826	22%	19:35	168670	21%	20:20	154615	20%	19:50	178972	20%	18:45	186498	22%
Sep	19:15	167334	19%	19:15	162965	23%	19:15	168937	20%	19:20	168791	22%	19:10	188615	22%
Oct	19:00	168001	19%	19:00	162545	20%	18:55	167893	20%	18:55	168912	20%	19:10	178758	21%
Nov	17:15	159651	13%	18:25	153431	17%	18:25	157661	18%	18:30	163833	18%	10:25	151418	7%
Dec	18:35	157026	15%	17:55	158415	13%	18:25	165346	14%	18:00	175503	14%	18:40	182837	15%
Jan	18:45	156571	15%	7:45	162928	15%	8:25	171092	14%	18:55	175054	13%	17:50	184539	15%
Feb	19:05	156543	14%	7:30	169258	14%	9:20	179469	9%	18:45	168161	14%			
Mar	19:25	163967	14%	7:25	161183	14%	19:20	174643	14%	19:30	183774	15%			

4. Thermal generation requirement for 2022-23

Following data has been considered to identify the month in which the requirement of thermal generation would be highest to meet all India demand:

a. Peak demand months has been identified based on energy requirement from thermal generation.
b. CEA monthly generation data has been utilized.

c. Average thermal generation has been calculated based on the thermal generation energy produced in respective months.

Details of thermal generation requirement and average thermal generation is given below:

Table 4: Thermal generation requirement

Month	2018-19		2019-20		2020-21		2021-22		2022-23	
	Thermal Generation (MU)	Average Thermal Generation (GW)	Thermal Generation (MU)	Average Thermal Generation (GW)	Thermal Generation (MU)	Average Thermal Generation (GW)	Thermal Generation (MU)	Average Thermal Generation (GW)	Thermal Generation (MU)	Average Thermal Generation (GW)
Apr	93004	129	94664	131	66806	93	103697	144	111583	155
May	96893	130	98839	133	77894	105	87507	118	108416	146
Jun	86665	120	94218	131	78147	109	85438	119	105618	147
Jul	82287	111	87372	117	85447	115	92427	124	94356	127
Aug	83403	112	80782	109	79034	106	96232	129	93230	125
Sep	87358	121	78980	110	85580	119	85319	118	93296	130
Oct	97586	131	79115	106	89644	120	90106	121	88186	119
Nov	88280	123	79533	110	82535	115	82709	115	94463	131
Dec	89957	121	86329	116	91411	123	93296	125	102942	138
Jan	90349	121	90803	122	97192	131	96292	129		
Feb	81402	121	89300	128	91299	136	92932	138		
Mar	95039	128	82812	111	107105	144	108761	146		

* Red color: High thermal generation requirement; Blue color: COVID-19 affected month
*Source : CEA monthly generation report.

5. Summary

a. Declaration of peak demand season and peak demand hours should be from the All-India perspective instead of regional perspective.

b. Requirement of thermal generation is high during the months of Mar, April and May because demand starts increasing on account of rise in temperature and support from hydro and wind generation is low. As mentioned in table-1, March is also peak month for WR &SR whereas April is peak month of SR &ER. In case of NR peak months are June, July and August which are high hydro and Wind season months due to which thermal generation contribution will be less. Hence the All India peak demand months satisfy the Western, Southern and Eastern regions to a large extent. As far as Northern Region is concerned, the electricity market surplus is available for meeting the high demand during June to August besides higher hydro and wind generation.

c. It would be observed that the All India peak thermal requirement months of March, April and May place a constraint on thermal generators for availing planned maintenance activities during these months. If we desire to satisfy both the regional peak and the national peak, the time barred periods for maintenance would only increase. This would have a long term impact on power plant availability.

d. With increasing penetration of RE sources, it is desirable to consider net demand in place of peak demand while declaring peak demand months with due consideration of all India hydro generation and seasonality.

e. Availability of thermal units should be maximized to ensure resource adequacy to meet coincident all India demand. Planned outages of thermal units should be minimized during the months when coincident all India net demand met is highest.

Annexe-II

Declaration of peak and off-peak months/season

CERC (Terms and Conditions of Tariff) regulations 2019

Declared Peak months for each region based on Demand met

- As of now, peaks are being declared inline with **clause 42(3)** of Central Electricity Regulatory Commission **(Terms and Conditions of Tariff) Regulations, 2019 for Thermal Generating Stations**.

> *"The High Demand Season (period of three months, consecutive or otherwise) and Low Demand Season (period of remaining nine months, consecutive or otherwise) in a region shall be declared by the concerned RLDC, at least six months in advance. Provided that RLDC, after duly considering the comments of the concerned stakeholders, shall declare Peak Hours and High Demand Season in such a way as to coincide with the majority of the Peak Hours and High Demand Season of the region to the maximum extent possible"*

- **High Demand Season declared by respective RLDC for FY 2023-24**

Northern Region	Western Region	Southern Region	Eastern Region	North Eastern Region
Jun-23	Dec-23	Apr-23	Apr-23	Jul-23
Jul-23	Jan-24	Feb-24	May-23	Aug-23
Aug-23	Mar-24	Mar-24	Jun-23	Sep-23

based on regional (gross) demand

- Accordingly, outages of thermal units are also being planned based on the respective regional demand
- Jun, Jul & Aug are high inflow months and therefore, availability of hydro generation capacity is being maximized (min. outage). This ensures the full (with overload capacity) generation during the period

Monthly all India energy met & thermal generation (MU)

	2018-19		2019-20		2020-21		2021-22		2022-23	
Month	All India Energy met	Thermal generation (coal + Lig)	All India Energy met	Thermal generation (coal + Lig)	All India Energy met	Thermal generation (coal + Lig)	All India Energy met	Thermal generation (coal + Lig)	All India Energy met	Thermal generation (coal + Lig)
Apr	105184	84739	111975	86963	85057	59433	119276	96012	132953	104910
May	112938	88149	121556	90320	102930	70078	110484	80536	136054	101367
Jun	109734	78568	118933	85585	106490	69650	115397	78211	134135	98464
Jul	110374	74330	116674	79132	113508	76199	125505	84546	128389	87582
Aug	113440	75965	112979	72839	110571	71061	129516	87938	130354	86804
Sep	110361	79572	108532	70862	113548	77338	114491	77956	127391	86735
Oct	113993	87791	100459	70550	110937	80969	114368	82464	114768	82587
Nov	100546	80837	95053	72038	98380	75105	100425	77581	112812	88778
Dec	103007	83196	102177	78969	107308	83939	110341	87851	121158	97135
Jan	103011	83349	106358	83688	111431	89822	112632	90955	126162	100725
Feb	94543	75614	104830	82075	104742	84512	109450	87864		
Mar	110326	88688	100202	75212	123046	99580	130260	102550		

Highlighted figures are more than 95% of maximum value in resp. year

- Thermal generation requirement during April, May and Mar is generally high.
- All India energy requirement is also high in other than April, May and Mar but adequate support from hydro and RE sources is available to meet the requirement.

All India net peak demand(MW) & contribution of Hydro generation

Month	2018-19			2019-20			2020-21			2021-22			2022-23		
	Time	Max Net demand	% hydro in Net dmd	Time	Max Net demand	% hydro in Net dmd	Time	Max Net demand	% hydro in Net dmd	Time	Max Net demand	% hydro in Net dmd	Time	Max Net demand	% hydro in Net dmd
Apr	19:40	156538	10%	22:55	170149	14%	22:40	126533	18%	19:30	175751	15%	22:25	190832	14%
May	22:50	163903	13%	22:50	173398	13%	22:30	151679	19%	0:00	161609	10%	22:45	181951	15%
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Sep	19:15	167334	19%	19:15	162965	23%	19:15	168937	20%	19:20	168791	22%	19:10	188615	22%
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Dec	18:35	157026	15%	17:55	158415	13%	18:25	165346	14%	18:00	175503	14%	18:40	182837	15%
Jan	18:45	156571	15%	7:45	162928	15%	8:25	171092	14%	18:55	175054	13%	17:50	184539	15%
Feb	19:05	156543	14%	7:30	169258	14%	9:20	179469	9%	18:45	168161	14%			
Mar	19:25	163967	14%	7:25	161183	14%	19:20	174643	14%	19:30	183774	15%			

Highlighted figures(red) are more than 95% of maximum value in resp. year

- Support from Hydro generation is highest during Jun, Jul, Aug and Sept.

All India maximum thermal generation(MW)

Month	2018-19	2019-20	2020-21	2021-22	2022-23
Apr	127055	137429	93949	146081	152083
May	132222	137992	112501	136630	150859
Jun	124851	136047	115204	134601	148581
Jul	117177	125159	117726	137548	137352
Aug	117112	119603	115760	132937	140155
Sep	125718	114110	124185	123148	139892
Oct	126726	119034	125461	125868	133399
Nov	124109	115983	121662	128570	141851
Dec	131245	128429	133866	143603	152220
Jan	127945	131482	143586	143346	151719
Feb	127666	135883	141547	143099	
Mar	133014	128050	141220	149033	

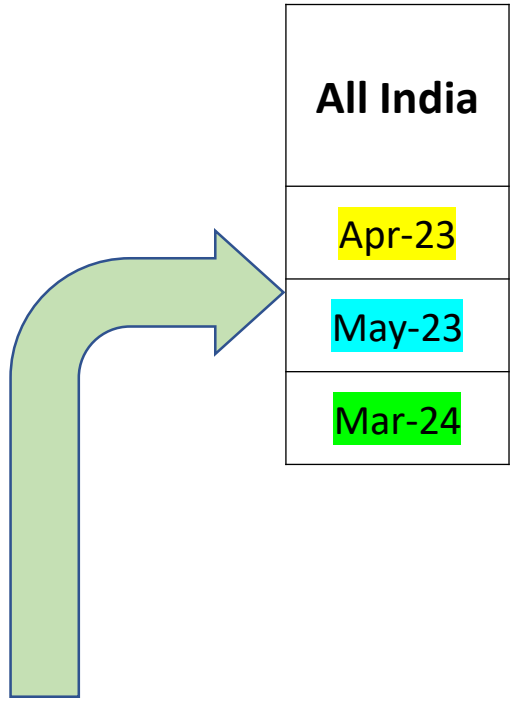
Highlighted figures(ex-bus) are more than 95% of maximum value in resp. year

Declared Peak months for each region and all India high thermal requirement months

High Demand Season declared by respective RLDC for FY 2023-24

Northern Region	Western Region	Southern Region	Eastern Region	North Eastern Region
Jun-23	Dec-23	Apr-23	Apr-23	Jul-23
Jul-23	Jan-24	Feb-24	May-23	Aug-23
Aug-23	Mar-24	Mar-24	Jun-23	Sep-23

Based on regional (gross) demand



Considerations for All India peak:

1. Peak demand months has been identified based on energy requirement from thermal generation.
2. CEA monthly generation data has been utilized. Average thermal generation has been calculated based on the thermal generation energy produced in respective months.
3. Maximum net load along with hydro penetration.

Summary

- Declaration of peak demand season and peak demand hours should be from the All-India perspective instead of regional perspective.
- Requirement of thermal generation is high during the months of Mar, April and May because demand starts increasing on account of rise in temperature and support from hydro and wind generation is low. Regional peak months which are coinciding with national peak are as follows:
  - ✓ March is peak month for WR &SR whereas April is peak month of SR &ER.
  - ✓ In case of NR, peak months are June, July and August which are high hydro and Wind season months due to which thermal generation contribution will be less.
  - ✓ All India peak demand months satisfy the Western, Southern and Eastern regions to a large extent.
- It would be observed that the All India peak thermal requirement months of March, April and May place a constraint on thermal generators for availing planned maintenance activities during these months. If we desire to satisfy both the regional peak and the national peak, the time barred periods for maintenance would only increase. This would have a long term impact on power plant availability.
- With increasing penetration of RE sources, it is desirable to consider net demand in place of peak demand while declaring peak demand months with due consideration of all India hydro generation and seasonality.
- Availability of thermal units should be maximized to ensure resource adequacy to meet coincident all India demand.

Thanks