



# Ensuring Grid Discipline

Developments under the deviation settlement mechanism

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Grid frequency indicates the over- or under-generation of electrical power, and deviations therein signify an unstable power system network. Therefore, grid discipline has a crucial role to play in ensuring grid stability.

**Grid discipline in the Indian power sector**  
Before the introduction of availability-based tariff (ABT) in 2002, power generators and state electricity boards pumped in and withdrew power from the grid in an unregulated manner, causing large frequency fluctuations. A three-part tariff (capacity charge, energy charge and unscheduled power interchange) scheme, ABT aimed at maintaining grid discipline through incentives and disincentives during unscheduled power interchange (UI). It also helped in tightening the normal operating grid frequency range to 49.5 Hz-50.2 Hz.

However, even after the introduction of the UI mechanism, distribution utilities continued to draw excess power from the grid to meet consumer demand and overtook the need to plan for sufficient generation. Similarly, generation utilities resorted to either underinjection or overinjection of power, deviating from their schedules. Both distribution and generation utilities used the UI platform as a de facto trading platform, leading to massive frequency excursions and eventually some big grid failures in 2012.

Thus, in 2014, the Central Electricity Regulatory Commission (CERC) brought in the deviation settlement mechanism (DSM) regulations for improving grid discipline and security. Under DSM, strict volume limits for overdrawal/underdrawal and over/underinjection of electricity were set, and additional deviation charges were introduced for any

breach. The operational frequency band was also tightened further to 49.7-50.1 Hz, and the deviation charges payable were revised, keeping in mind the improved frequency profile of the grid.

**DSM regulations and amendments**

Under the regulations that came into force on February 17, 2014, charges payable to or receivable by states were to be managed through a common DSM pool. The mechanism had three basic components:

- Deviation charges that are applicable beyond specific volume limits (12 per cent of the schedule or 150 MW) during all time blocks;
- Additional deviation charges that are frequency dependent and different for renewables-rich and renewables-deficient states;
- Sustained deviation, which buyers/sellers should avoid by changing their sign of deviation from the schedule once after every 12 time blocks. There are no charges in case of violation.

For wind and solar generators, the deviation charges were calculated on the basis



of deviations from the schedule at a fixed rate defined in their power purchase agreement. A deviation of +/- 15 per cent from the available capacity was allowed.

Over the years, these regulations have undergone various amendments. The first amendment in December 2014 added limits for underdrawal/overinjection for frequencies of 50.1 Hz and above, and for overdrawal/underinjection for frequencies below 49.7 Hz, while the second amendment in August 2015 specifically exempted wind and solar generators from deviations on volume limits. The third amendment of May 2016 further relaxed the volume limits for underdrawal/overinjection for wind and solar generators, considering the intermittent and variable nature of these sources.

Expansion of the power system network requires the grid frequency to be in a permissible range so as to withstand contingencies and avoid grid collapse/failure. Thus, the fourth DSM regulations amendment in January 2019 brought in major changes, tightening the frequency band further to 49.85-50.05 Hz. Also, the deviation charges for deviations below a frequency of 49.85 Hz were reduced to 800 paise per unit (from 824 paise per unit in 2014) and for a frequency equal to more than 50.05 Hz, no charges were applicable.

For deviations at 50 Hz frequency, the charges were linked with dynamic market pricing based on the daily average area clearing price (ACP) with a ceiling price of 800 paise per unit. The buyer/seller was required to switch the sign of their deviation from the schedule at least once after every six time blocks (previously 12 time blocks) to circumvent a continuous divergence in one direction

(positive or negative). While there were no additional charges for sign violation earlier, the fourth amendment imposed an additional charge equal to 20 per cent of the daily base DSM payable/receivable for each violation.

In May 2019, the CERC recommended a fifth amendment to reduce the technical and commercial obstacles faced by stakeholders in implementing the regulations. While two new deviation charges: daily-base DSM (sum of deviation charges for all time blocks in a day, excluding additional charges due or receivable), and time-block DSM (deviation charge for a particular time period in a day that is due or payable, excluding the additional charges) were brought in. The main change was the introduction of deviation charges payable in case of sign change violation. The amendment revised the sign change duration to 12 time blocks up to March 31, 2020. The additional deviation charges were fixed at 10 per cent of deviation charge of a time-block. Beyond this date, the duration was to be retained to six time blocks, with corresponding changes to the additional deviation charges based on specific time blocks. In addition to the above, a tolerance range of ± 10MW was allowed for such violation. This provision of sign change was not applicable to renewable energy generators.

**DSM Regulations 2022**

With the main objective of delinking the deviation charges and frequency band, the Regulations, 2022 DSM came into force in December 2022, repealing the 2014 regulations. The CERC observed that frequency-linked price arbitrage may not be a good indicator of surplus/deficit generation in the absence of large frequency deviations. Further, with the introduction of centralised ancillary services regulations, a decentralised mechanism for frequency control might prove to be counter-productive.

The DSM Regulations 2022, therefore, stipulated that all buyers and sellers will adhere to their schedules and the system operator will manage any deviations

through ancillary services. The regulations further proposed that the normal deviation charges for a time block be equal to the highest of the weighted average ACP of the day-ahead market (DAM) or real-time market (RTM) segments of all the power exchanges or the weighted average ancillary service charge of all the regions for that time block. The generators (other than run-of-river generating station, municipal solid waste, wind and solar) were allowed a deviation of up to 2 per cent overinjection during a time block, beyond which the generator would pay additional deviation charges at the rate of 10 per cent of the normal deviation charges. For under-injection up to 2 per cent during a time-block, the generators would pay deviation charges at the normal rate, while beyond 2 per cent they would pay 110 per cent of the normal deviation charges.

The wind and solar generators will not have to pay any deviation charges for over injection. In the case of under-injection, they will be exempt from charges up to a deviation of 10 per cent (reduced from the current deviation range of +/- 15 per cent from the schedule, but for deviations beyond 10 per cent, the generators will have to pay deviation charges equal to 10 per cent of the normal deviation charges applicable during that time block.

However, on December 26, 2022, within two weeks of the introduction of the DSM Regulations, 2022, the grid experienced massive frequency fluctuations, revealing the inadequacy of system resources for supporting the grid. Therefore, the CERC requested states to procure adequate resources in advance to cater to the demand and develop long-term and short-term resource adequacy plans, along with planning reserve margins (PRMs) for contingencies. Also, post the 2022 regulations, the deviation charges were observed to be as high as Rs 40 per kWh, due to the high cost of ancillary services deployed during the concerned time block. To address the issue, the CERC, in its February 6, 2023 guidelines, capped the normal rate of

deviation charges at Rs 12 per kWh. The deviation charges under the 2022 regulations were retained but two new categories: wind-solar generator based on wind resource, and wind-solar generator based on solar or wind-solar hybrid) were introduced. The new guidelines also linked the monetary incentives for frequency deviations.

Subsequently, to facilitate the participation of high variable cost generators (such as imported RLNG and naphtha-based gas plants, imported coal-based plants and battery energy storage systems), on February 16, 2023, the CERC introduced the high-price day-ahead market (HP-DAM) in the integrated DAM segment. It revised the price ceiling for HP-DAM to Rs 20 per kWh, and for other market segments to Rs 10 per kWh. To ensure grid security and avoid any malpractices because of the new HP-DAM segment, the CERC, in its late guidelines on April 9, 2023, notified the normal rate of deviation charge a time block would be higher than weighted average ACP of the DAM. RTM segments of all the power exchanges for that time block. For sellers, bids declared in HP-DAM, deviation charges for underinjection would be the highest of the weighted average ACP of the HP-DAM, DAM, or RTM segments of all power exchanges on the quantum of power sold in the HP-DAM.

**The way forward**

While the DSM regulations have helped in maintaining grid balance and stability, with the increased penetration of variable renewable energy, accurate forecasting and scheduling have become crucial. This should be complemented by capacity building and training of power system operators and technical staff on new technologies and developments in the forecasting and scheduling space. Since electricity is a concurrent subject, each state has set its own targets/deviation charges under DSM. However, bringing in uniformity across states on penalties and incentives related to DSM regulations can enable consistency in implementation. ■



