No. 402 Registered No. N. E. 930.

TRIPURA GAZETTE

Published by Authority

EXTRAORDINARY ISSUE

Agartala, Friday, November 18, 2016 A. D, Kartika 27, 1938 S. E.

PART--I-- Orders and Notifications by the Government of Tripura, The High Court, Government Treasury etc.

TRIPURA ELECTRICITY REGULATORY COMMISSION

No.F/25/ TERC/ 09 / Dated, 24th June, 2016

NOTIFICATION

In exercise of the powers conferred under Section 181 of the Electricity Act, 2003 (36 of 2003), and all other powers enabling it in this behalf, the Tripura Electricity Regulatory Commission hereby makes the following regulations, namely:

1. Short title and commencement

(1) These regulations may be called the Tripura Electricity Regulatory Commission (Forecasting, Scheduling, Deviation Settlement and Related Matters of Solar and Wind Generation Sources) Regulations, 2016.

(2) These Regulations shall come into force from the date of their publication in the **Official Gazette of Govt. of Tripura.**

2. Definitions and Interpretation

(1) In these regulations, unless the context otherwise requires,-

(a) **'Absolute Error'** means the absolute value of the error in the actual generation of wind or solar generators with reference to the scheduled

generation and the 'Available Capacity' (AvC), as calculated using the following formula for each 15 minute time block:

Error (%) = 100 X [Actual Generation– Scheduled Generation] / (AvC) ;

(b) **'Act'** means the Electricity Act, 2003 (36 of 2003);

(c) **'actual drawal'** in a time-block means electricity drawn by a buyer, as the case may be, measured by the interface meters;

(d) **'actual injection'** in a time-block means electricity generated or supplied by the seller, as the case may be, measured by the Interface meters;

(e) **'Available Capacity or AvC'** for wind or solar generators means the cumulative capacity rating of the wind turbines or solar inverters that are capable of generating power in a given time-block;

(d) '**beneficiary**' means a person purchasing electricity generated from a generating station;

(e) **'buyer'** means a person, including beneficiary, purchasing electricity through a transaction scheduled in accordance with the regulations applicable for short-term open access, medium-term open access and long-term access;

(f) **'CERC'** means the Central Electricity Regulatory Commission referred to in sub-section (1) of section 76 of the Act;

(g) **'deviation'** in a time-block for a seller means its total actual injection minus its total scheduled generation and for a buyer means its total actual drawal minus its total scheduled drawal;

(h) **'gaming'** in relation to these regulations, shall mean an intentional mis-declaration of available capacity or schedule by any seller in order to make an undue commercial gain through Charge for Deviations;

(i) **'Grid Code'** means the Grid Code specified by Tripura Electricity Regulatory Commission under clause (h) of sub-section (1) of Section 86 of the Act;

(j) **'IEGC'** means Indian Electricity Grid Code specified by CERC under clause (h) of sub-section (1) of Section 79 of the Act;

(k) **'Interface meters'** 'Interface Meter' means a meter used for accounting and billing of electricity, connected at the point of interconnection between electrical systems of generating company, licensee and consumers, directly connected to the Inter-State Transmission System or Intra-State Transmission System who have to be covered under ABT and have been permitted open access by the Appropriate Commission;

(l) **'Pool Account'** means state account for receipts and payments on account of deviation by buyers or sellers including wind and solar generators;

(m) **'Pooling station'** means the sub-station where pooling of generation of individual wind generators or solar generators is done for interfacing with the next higher voltage level: Provided that where there is no separate pooling station for a wind / solar generator and the generating station is connected through common feeder and terminated at a sub-station of distribution company/STU/CTU, the sub-station of distribution company/STU/CTU shall be considered as the pooling station for such wind/solar generator, as the case may be;

(n) **'Qualified Coordinating Agency or QCA'** means the agency coordinating on behalf of Wind/Solar Generators connected to a pooling station. QCA may be one of the generators or any other mutually agreed agency for the following purposes:

- Provide schedules with periodic revisions as per this regulation on behalf of all the Wind/Solar Generators connected to the pooling station(s),
- Responsible for metering, data collection/transmission, communication, coordination with DISCOMS, SLDC and other agencies.
- Undertake commercial settlement of all charges on behalf of the generators, including payments to the State UI pool accounts through the concerned SLDC.
- Undertake de-pooling of payments received on behalf of the generators from the State UI Pool account and settling them with the individual generators

- Undertake commercial settlement of any other charges on behalf of the generators as may be mandated from time to time.

QCA shall be treated as a State Entity.

(o) '**Scheduled generation'** at any time or for a time block or any period means schedule of generation in MW or MWh ex-bus given by the concerned Load Despatch Centre;

(p) '**Scheduled drawal'** at any time or for a time block or any period time block means schedule of despatch in MW or MWh ex-bus given by the concerned Load Despatch Centre;

(q) **'Seller'** means a person, including a generating station, supplying electricity through a transaction scheduled in accordance with the regulations applicable for short-term open access, medium-term open access and long-term access;

(r) **'State Commission'** means (State) Electricity Regulatory Commission established under sub-section 1 of Section 82 of the Act;

(s) **'State Entity'** means an entity which is in the SLDC control area and whose metering and energy accounting is done at the state level;

(t) **'State Load Despatch Centre or SLDC'** means Load Despatch Centre of the State, established under sub-section (1) of Section 31 of the Act, responsible for coordinating scheduling of the state entities in accordance with the provisions of the State Grid Code;

(u) '**Time-block'** means a time block of 15 minutes, for which specified electrical parameters and quantities are recorded by special energy meter, with first time block starting at 00.00 hrs;

(2) Save as aforesaid and unless repugnant to the context or the subject-matter otherwise requires, words and expressions used in these regulations and not defined, but defined in the Act, or the Grid Code or any other regulations of this Commission shall have the meaning assigned to them respectively in the Act or the Grid Code or any other regulation.

PART – 1 GENERAL

1.1 Objective

The objective of these regulations is to 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 of these generators.

1.2 Applicability of the Regulations

a. All wind and solar generators connected to the State grid, including those connected via pooling stations, and selling power within or outside the State.

PART – 2 FORECASTING AND SCHEDULING CODE

2.1. This code provides methodology for day-ahead scheduling of wind and solar energy generators which are connected to the State grid and re-scheduling them on one and half hourly basis, and the methodology of handling deviations of such wind and solar energy generators. Appropriate meters shall be provided for energy accounting. Telemetry/communication system & Data Acquisition System shall also be provided for transfer of information to the concerned SLDC.

2.2. Wind and Solar generators, represented via Qualified Coordinating Agencies (QCAs), shall mandatorily provide to the concerned SLDC, in a format as prescribed by SLDC, the technical specifications at the beginning and whenever there is any change. The data relating to power system output & parameters and weather related data as applicable shall also be mandatorily provided by such generators to the concerned SLDC in real time.

2.3.

(i). Forecasting shall be done by wind and solar generators below 1MW capacity connected to the State grid, through QCAs on their behalf.

(ii). Forecasting shall be done by wind and solar generators above 1MW capacity connected to the State grid, or by QCAs on their behalf.

The concerned SLDC is also mandated to undertake forecasting of wind and solar power that is expected to be injected into the State grid, by engaging forecasting agency (ies) if required. The forecast by the concerned SLDC shall be with the objective of ensuring secure grid operation by planning for the requisite balancing resources. The forecast by the QCA or wind and solar generator, as the case may be, shall be

generator centric. The QCA or wind and solar generators will have the option of accepting the SLDC's forecast for preparing its schedule or provide the SLDC with a schedule based on their own forecast. The QCA shall coordinate the aggregation of schedules of all generators connected to a pooling station and communicate it to the SLDC.

2.4. The QCA or the wind and solar generator shall submit a day-ahead and week-ahead schedule for each pooling station or each generating station, as the case may be. Day-ahead schedule shall contain wind or solar energy generation schedule at intervals of 15 minutes (time-block) for the next day, starting from 00:00 hours of the day, and prepared for all 96 time-blocks. Week-ahead schedule shall contain the same information for the next seven days.

2.5. The schedule of wind and solar generators connected to the State grid (excluding collective transactions) may be revised by giving advance notice to the SLDC. Such revisions shall be effective from 4th time block, the first being the time-block in which notice was given. There may be one revision for each time slot of one and half hours starting from 00:00 hours of a particular day subject to maximum of 16 revisions during the day.

2.6. The plan for data telemetry, formats of forecast submission and other details in this regard shall be provided in the Detailed Procedure to be prepared by SLDC and approved by the State Commission.

2.7. Any commercial impact on account of deviation from schedule based on the forecast shall be borne by the wind and solar generator, either directly or transacted via the representing QCA.

PART – 3 COMMERCIAL AND DEVIATION SETTLEMENT

3.1. (a) The wind or solar generators connected to the State grid and selling power within the State shall be paid by the buyer as per actual generation. (b) The wind or solar generators connected to the State grid and selling power outside the State shall be paid by the buyer as per scheduled generation.

3.2. The wind and solar generator or the QCA, as the case may be, shall have the option of accepting the concerned SLDC's forecast for preparing its schedule or provide the concerned SLDC with a schedule based on its own forecast, and such schedule shall be used as reference for deviation settlement.

3.3. The QCA shall undertake all commercial settlement on behalf of the generator(s) connected to the respective pooling station(s).

3.4. In the event of actual generation of a generating station or a pooling station, as the case may be, being less or more than the scheduled generation, the deviation charges for shortfall or excess generation shall be payable by the wind and solar generator or the QCA, as the case may be, to the State DSM Pool, as given in Table – I below:

Table–I: Deviation Charges in case of under or over-injection, for sale of power within the State

Sr. No.	Absolute Error in the 15-minute time block	Deviation Charges payable to State DSM Pool
1	< = 10%	None
2	>10% but <=20%	At Rs. 0.50 per unit for the shortfall or excess energy for absolute error beyond 10% and upto 20%
3	>20% but <=30%	At Rs. 0.50 per unit for the shortfall or excess energy beyond 10% and upto 20% + Rs. 1.0 per unit for balance energy beyond 20% and upto 30%
4	> 30%	At Rs. 0.50 per unit for the shortfall or excess energy beyond 10% and upto 20% + Rs. 1.0 per unit for shortfall or excess energy beyond 20% and upto 30% + Rs. 1.50 per unit for balance energy beyond 30%

Provided that deviation charges for under or over injection by wind or solar generator connected to the State grid and selling power outside the State shall be payable or receivable as per the framework provided in **Appendix – I.** The accounting for this purpose shall be done by the SLDC.

3.5. The QCA shall also de-pool the energy deviations as well as deviation charges to each generator using one of the following options:

(a) In proportion to actual generated units for each time-block for each generator

(b) In proportion to available capacity of each generator

3.6. The State shall maintain separate records and account of time-block wise schedules, actual generation and deviations for all generators, including wind and solar generators.

3.7. Once the accounting procedures as above are put in place, all RE generators shall be treated together as a virtual pool within the State Pool. Deviations for and within this virtual pool could be settled first at the rates and methodology stipulated above for wind and solar generators.

3.8. Annual accounts as mentioned above shall be prepared by the SLDC. The illustration in this regard is at Appendix - II to these regulations. In case there is deficit in the overall pool at the end of the year, the SLDC may approach the National Funds such as PSDF or NCEF to cover such deficit.

PART – 4 MISCELLANEOUS

4.1 Power to Relax

The Commission may by general or special order, for reasons to be recorded in writing, and after giving an opportunity of hearing to the parties likely to be affected by grant of relaxation, may relax any of the provisions of these regulations on its own motion or on an application made before it by an interested person.

4.2 Power to issue directions

If any difficulty arises in giving effect to these regulations, the Commission may on its own motion or on an application filed by any affected party, issue such directions as may be considered necessary in furtherance of the objective and purpose of these regulations.

By order of Commission

Secretary,
TERC

Dated ,24th June' 2016 Tripura Electricity Regulatory Commission, Agartala

Appendix –I

Framework for deviation charges for under or over injection by generator connected to the State grid and selling power outside the State

The wind or solar generators connected to the State grid and selling power outside the State boundary shall be paid as per schedule.

a) In the event of actual generation being less than the scheduled generation, the deviation charges for shortfall in generation shall be payable by such wind or solar generator, or the QCA on their behalf, to the State DSM Pool as given in Table – 1 below:

Table – I: Deviation Charges in case of under injection

Sr. No.	Absolute Error in the 15-minute time block	Deviation Charges payable to State DSM Pool
1	< = 15%	At the Fixed Rate for the shortfall energy for absolute error upto 15%
2	>15% but <= 25%	At the Fixed Rate for the shortfall energy for absolute error upto 15% + 110% of the Fixed Rate for balance energy beyond 15% and upto 25%
3	>25% but <=35%	At the Fixed Rate for the shortfall energy for absolute error upto 15% + 110% of the Fixed Rate for balance energy beyond 15% and upto 25% + 120% of the Fixed Rate for balance energy beyond 25% and upto 35%
4	> 35%	At the Fixed Rate for the shortfall energy for absolute error upto 15% + 110% of the Fixed Rate for balance energy beyond 15% and upto 25% + 120% of the Fixed Rate for balance energy beyond 25% and upto 35% + 130% of the Fixed Rate for balance energy beyond 35%

Where the Fixed Rate is the PPA rate as determined by the Appropriate Commission under section 62 of the Act or adopted by the Appropriate Commission under section 63 of the Act. In case of multiple PPAs, the

weighted average of the PPA rates shall be taken as the Fixed Rate. The wind and solar generators shall furnish the PPA rates on affidavit for the purpose of Deviation charge account preparation to respective SLDC supported by copy of the PPA. Fixed Rate for Open Access participants selling power which is not accounted for RPO compliance of the buyer, and the captive wind or solar plants shall be the Average Power Purchase Cost (APPC) rate at the National level, as determined by CERC from time to time.

b) In the event of the actual generation being more than the scheduled generation, the Deviation Charges for excess generation shall be payable to the wind or solar generator, or the QCA on their behalf, from the State DSM Pool as given in Table – II below:

Table – II: Deviation Charges in case of over injection

Sr. No.	Absolute Error in the 15-minute time block	Deviation Charges payable
1	< = 15%	At the Fixed Rate for excess energy upto 15%
2	>15% but <= 25%	At the Fixed Rate for excess energy upto 15% + 90% of the Fixed Rate for excess energy beyond 15% and upto 25%
3	>25% but <=35%	At the Fixed Rate for excess energy upto 15% + 90% of the Fixed Rate for excess energy beyond 15% and upto 25% + 80% of the Fixed Rate for excess energy beyond 25% and upto 35%
4	> 35%	At the Fixed Rate for excess energy upto 15% + 90% of the Fixed Rate for excess energy beyond 15% and upto 25% + 80% of the Fixed Rate for excess energy

Where the Fixed Rate is the PPA rate as determined by the Appropriate Commission under section 62 of the Act or adopted by the Appropriate Commission under section 63 of the Act. In case of multiple PPAs, the weighted average of the PPA rates shall be taken as the Fixed Rate. The wind and solar generators shall furnish the PPA rates on affidavit for the

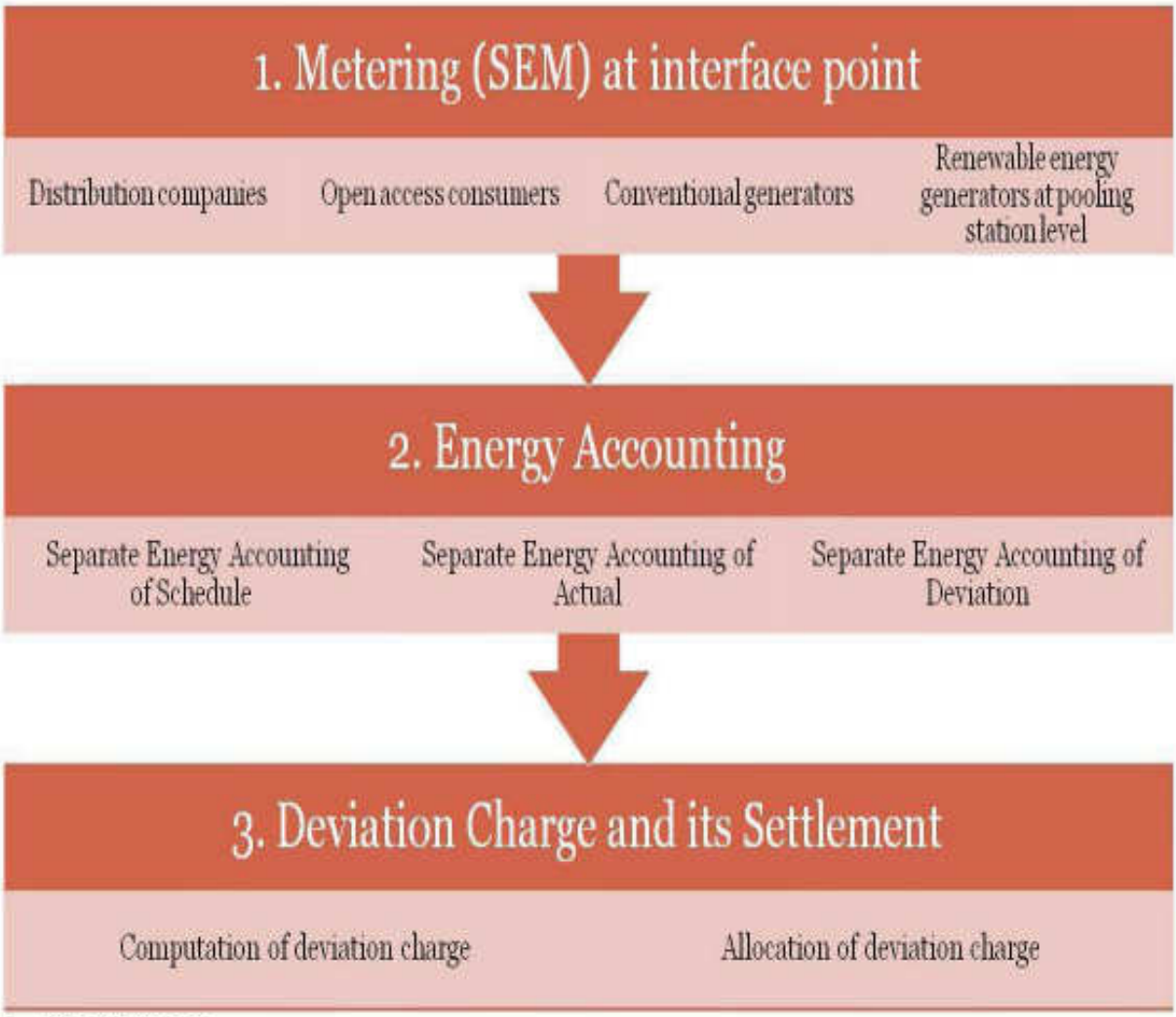
purpose of Deviation charge account preparation to respective SLDC supported by copy of the PPA. Fixed Rate for Open Access participants selling power which is not accounted for RPO compliance of the buyer, and the captive wind or solar plants shall be the Average Power Purchase Cost (APPC) rate at the National level, as determined by the CERC from time to time.

c) In reference to clauses (a) and (b) as above, for balancing of deemed renewable purchase obligation (RPO) compliance of buyers with respect to schedule, deviations by all wind and solar generators which are selling power outside the State boundary shall first be netted off for the entire pool on a monthly basis and any remaining shortfall in renewable energy generation must be balanced through purchase of equivalent solar and non-solar Renewable Energy Certificates (RECs), as the case may be, by SLDC by utilising funds from the Pool Account. For positive balance of renewable energy generation, equivalent notional RECs shall be credited to the State DSM Pool and carried forward for settlement in future.

Appendix –II

Metering, Energy and Deviation Accounting

Separate metering, schedule preparation, accounting of actual generation/drawl, accounting of energy deviations and deviation settlement shall be undertaken for different types of entities in the State. The complete accounting process will be operationalized in the following manner:



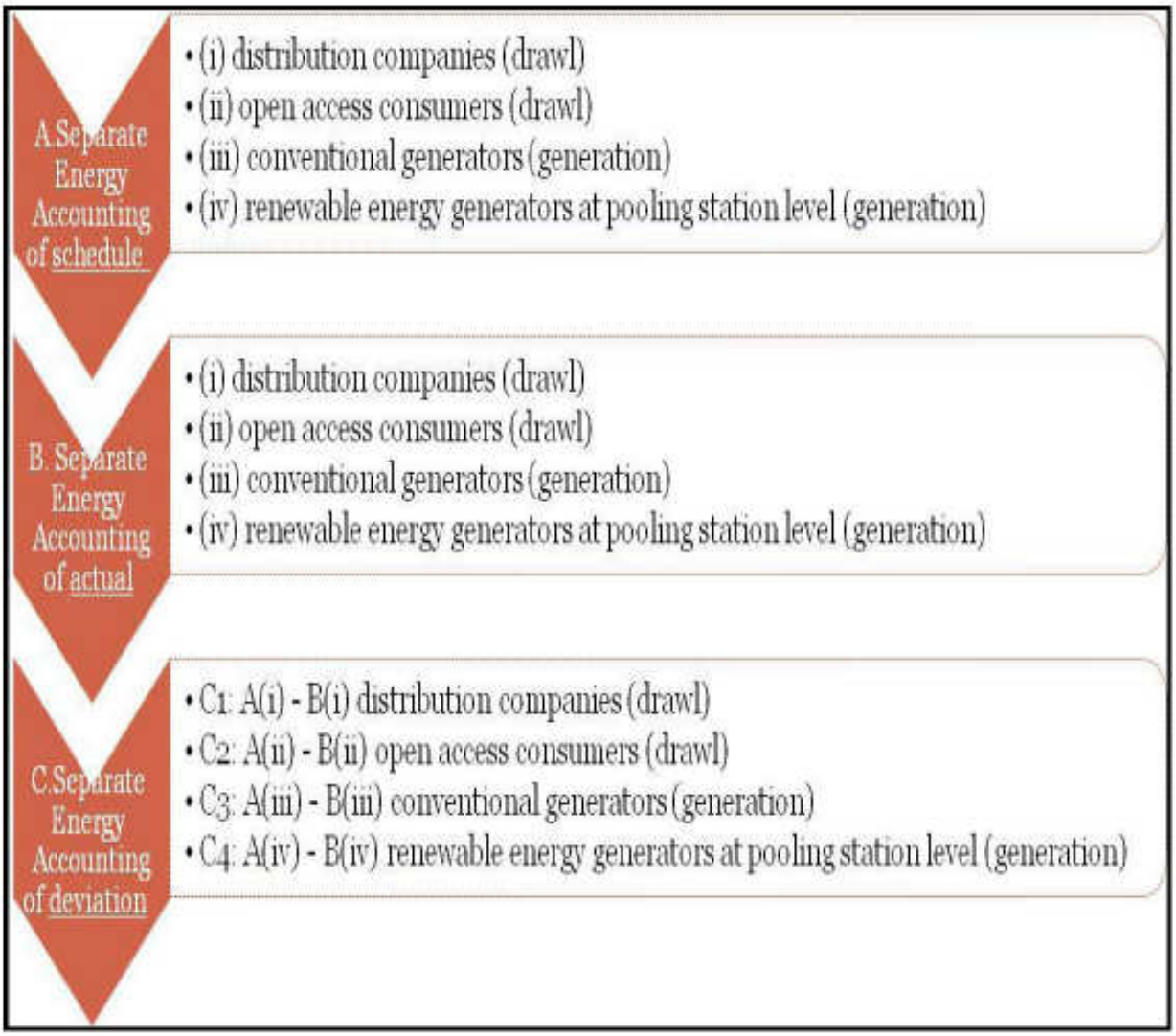
1. Metering:

Interface Metering for intra-state entities shall be undertaken on an urgent basis. Every entity must be metered with a Special Energy Meter

(SEM) shall be complying with the provision of CEA (Installation and Operation of Meters) Regulations'2006 as on amended time to time.

2. Energy Accounting

Every intra-State grid connected entity shall be metered with a Special Energy Meter (SEM), and the energy accounting for each such entity shall be done in the following manner:-



3. Deviation Settlement

Deviation settlement for the State shall be governed by the following provisions:

Stage– 1: Transitional Arrangement

3.1 Computation of Deviation Charge

Deviation charges shall be computed in the following manner:-

3.1.1. Deviation Charge (D) payable/receivable for the State as a whole at the State periphery shall first be computed.

3.1.2. Deviation charge (R1) from the pooling stations/RE generators based on these regulations, shall be collected and pooled in the State DSM Pool

3.2 Settlement of deviation charge

Deviation charge as above shall be allocated to different grid connected entities in the following manner:-

3.2.1 Deviation charge shall be allocated (D) amongst the distribution companies/OA consumers/conventional generators/RE generators in proportion to their respective deviation viz., C1/C2/C3/C4

3.2.2 For RE generators, assuming (i) the share out of State level deviation charge as D4 and (ii) receipt of deviation charge from RE generators (Pooling station) based on the charges for deviation as per the model regulation, as R1 - actual commercial impact for the State as a result of deviation of RE generation would be D4-R1

This amount (D4 - R1 if greater than zero) can be refunded to the State DSM pool from PSDF/NCEF.

Stage – 2: Long-Term Arrangement:

3.3 Computation of Deviation Charge

3.3.1 Compute Deviation Charge (D) payable/receivable for the State as a whole at the State periphery

3.3.2 Implement Deviation Settlement Mechanism(DSM) for conventional generators on lines of CERC DSM or any other variant, that is, determine in advance the deviation charge payable/receivable by all grid connected entities within the state

3.3.3 Implement DSM mechanism for RE generators on lines of model regulation and collect in the State DSM pool, deviation charge (R1) from the pooling stations/RE generators based on the said model

3.4 Settlement of deviation charge

3.4.1 Compute for the distribution companies / OA consumers / conventional generators, the deviation charges payable/receivable by them in proportion to their respective deviation viz., C1/C2/C3 (this should be as per State level DSM)....(assume net balance as D1)

3.4.2 In respect of RE generators, collect deviation charge from the RE generators (Pooling station) based on the charges for deviation as per the model regulation (assume as R1)

3.4.3 Actual commercial impact for the State as a result of deviation of RE generation would be D4-R1

If D is greater than (D1+R1), the differential be made good from the PSDF/NCEF.

EXPLANATORY MEMORANDUM

1. Background

The Central Electricity Regulatory Commission published the Framework on Forecasting, Scheduling and Imbalance Handling for Variable Renewable Energy Sources (Wind and Solar) on 7th August, 2015. This framework is applicable for solar and wind generators that are regional entities, that is, their scheduling and settlement is handled by the respective Regional Load Dispatch Centre (RLDC). The framework is constituted of amendments to Grid Code and the DSM Regulations:

- Central Electricity Regulatory Commission (Indian Electricity Grid Code) (Third Amendment) Regulations, 2015.
- Central Electricity Regulatory Commission (Deviation Settlement Mechanism and related matters) (Second Amendment) Regulations, 2015.

This framework envisages that bulk of wind and solar capacity expected to come online over the next 7 years, in alignment with Government's target of 100 GW solar and 60 GW wind by 2022, shall be inter-state in nature. That is, these generating stations shall sell power within as well as outside the host state, and connect directly to the CTU grid. This will become essential as a few states are rich in solar and wind resources, whereas the Renewable Purchase Obligations (RPOs) shall ensure that the whole country takes advantage of renewable power, while marching towards the national goal of *universal*

electrification. This Framework has opened up the country-wide market to such solar and wind generators that shall be under RLDC's jurisdiction.

However, presently all of the existing wind and solar generating stations are directly connected to the State grid, and thus fall under operational control area of the respective State Load Dispatch Centres (SLDCs). Presently, (....) MW of wind and (....) MW of solar is installed in the State of Tripura. The proposed regulations seek to address the grid integration aspects related to such wind and solar generators directly connected to the State grid.

2. Objective & Scope

The objective of these regulations is to 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 of these generators. It is essential that the grid operator has visibility into how much renewable energy (RE) is expected to be injected into the grid. This is especially critical for variable and uncertain sources such as wind and solar. Forecasting and scheduling of these generators is critical to anticipate balancing requirements and procure requisite reserves to maintain load-generation balance and grid reliability. At the same time, due to the intermittent nature of these sources, special provisions must be made so that the generators are not unduly penalized. These regulations are intended to cover all wind and solar generators connected to the State grid, directly or via pooling stations. Majority of these generators are selling power within the State. Additionally, some wind and solar generators are connected to the State grid but selling their power wholly outside the State, or partly within the State and partly outside the State boundary. All solar and wind generators connected to the State grid fall under the purview of these regulations, irrespective of nature of transactions.

3. Proposed Framework

3.1. Introduction of Aggregators

The fragmented nature of the industry which is evident from the large number of owners of wind turbines poses a challenge of direct interaction of these generators with the respective SLDCs. This process can quickly become unwieldy due to the sheer number of turbine owners. Secondly, benefits of aggregation on forecasting accuracy are well documented. Keeping in view the above reasons, the Commission proposes to formalize a new aggregator entity, termed as Qualified Coordinating Agency or the QCA. This aggregator or the QCA shall

coordinate all forecasting, scheduling and commercial settlement processes for all wind or solar generators connected to a pooling station. The QCA might aggregate one or more pooling stations, and several QCAs may come together to aggregate even at the State level for leveraging maximum benefit of aggregation. The QCAs shall interact with the SLDC (or RLDC, if required) on behalf of the generators. This significantly cuts down the complexity both for small generators as well as the SLDC, which now has to interact with a few number of agencies instead of thousands of generators.

The QCA might be a Principal Generator, as recognized in the Central Electricity Regulatory Commission (Grant of Connectivity, Long-term Access and Medium-term Open Access in inter-State Transmission and related matters) (Third Amendment) Regulations, 2013, or a third party. The proposed functions of the QCA are as follows:

Provide schedules with periodic revisions as per this regulation on behalf of all the Wind/Solar Generators connected to the pooling station,

- Responsible for metering, data collection and transmission, communication, coordination with DISCOMS, SLDC and other agencies.
- Undertake commercial settlement of all charges on behalf of the generators, including payments to the State UI pool accounts through the concerned SLDC.
- Undertake de-pooling of payments received on behalf of the generators from the State UI Pool account and settling them with the individual generators
- Undertake commercial settlement of any other charges on behalf of the generators as may be mandated from time to time.

The eligibility and empanelment of QCAs shall be outlined through a separate order.

It must be noted that this is not a compulsory requirement for the process. Some large solar or wind plants in future may encompass one or more pooling stations themselves. Such large generators may choose to interact directly with the respective SLDC, if desired.

3.2. Data Telemetry

Weather and power system data at the turbine or inverter level is essential for the grid operator to have accurate visibility into the availability and performance of RE stations connected to the grid. Metering and communication of real time data at the turbine/inverter level are mandated. This data shall also help the QCA for improving forecasting accuracy. Thus, special energy meters and communication infrastructure must be installed by all generators, and as such, this should be a requirement for approval of connectivity going forward. Special Energy Meters should also be installed at the pooling station level, to meter the power injected into the grid in every time-block.

The SLDC shall have to prescribe a format for accepting this data into their system, and define an internal process to assimilate and deploy this data. While SLDC may only receive data at the pooling station level, the QCA shall have to process data at the turbine level for improved forecasting and pooling/de-pooling of schedules/deviations.

3.3. Forecasting

Wind and solar sources are variable and uncertain in nature. Known variability such as high wind speeds during monsoon can be better predicted for large geographical areas, while uncertainty reduces closer to the time of injection. In fact, forecasting accuracy increases exponentially the closer it is to real-time.

Solar plants are now mandated to undertake forecasting. Notwithstanding the lack of indigenous experience, solar forecasting methodologies are quickly maturing worldwide and have higher accuracy levels than wind forecasting. While we are starting out and aiming for ambitious solar power targets, this is the opportune moment to ensure these plants connect to the grid in a sustainable and streamlined manner.

Forecasting should be done by wind and solar generators connected to the State grid, or by QCAs on their behalf. The concerned SLDC should also undertake forecasting of wind and solar power that is expected to be injected into the State grid, by engaging forecasting agency(ies) if required. The forecast by the concerned SLDC shall be with the objective of ensuring secure grid operation by planning for the requisite balancing

resources. The forecast by the QCA or wind and solar generator, as the case may be, shall be generator centric.

The QCA or wind and solar generators will have the option of accepting the SLDC's forecast for preparing its schedule or provide the SLDC with a schedule based on their own forecast. The QCA shall coordinate the aggregation of schedules of all generators connected to a pooling station (or a cluster of pooling stations) and communicate it to the SLDC. Such schedule shall be used as reference for deviation settlement.

The wind and solar generator or QCA should submit a day-ahead as well as week-ahead schedule for each generating station or each pooling station, as the case may be. In case the QCA is coordinating for several pooling stations, it should submit an aggregate schedule as well. Day-ahead schedule should contain wind or solar energy generation forecast at intervals of 15 minutes (time-block) for the next day, starting from 00:00 hours of the day, and prepared for all 96 time-blocks. Week-ahead schedule should contain the same information for the following seven days.

The accuracy of forecasting algorithm can be measured by computing the delta between scheduled and actual generation. Error may be defined as: 'Absolute Error' means the absolute value of the error in the actual generation of wind or solar generators with reference to the scheduled generation and the 'Available Capacity' (AvC), as calculated using the following formula for each 15 minute time block:

Error (%) = 100 X [Actual Generation– Scheduled Generation] / (AvC) ;

where Available Capacity or AvC for wind or solar generators means the cumulative capacity rating of the wind turbines or solar inverters that are capable of generating power in a given time-block.

Mean Absolute Error or MAE can be determined by averaging the absolute error over a day or week or year, etc. MAE should be tracked over time to ensure that 21
accuracy improves as more historical data is collected, and to benchmark against error % reported internationally. The Central Commission, in the Statement of Reasons (SOR) accompanying the Framework on Forecasting, Scheduling and Imbalance Handling for Variable Renewable

Energy Sources (Wind and Solar), has noted that the definition of error, calculated w.r.t schedule, does not adequately address instances such as low/no generation cases, such as during low wind season, where close to zero schedules would result in high numerical errors but with no real impact on grid. Additionally, incentives to generators for better forecasting must be aligned with the objective of grid management, which is to minimize actual MW deviations from schedule. As commercial impact on generators is directly proportional to the error percentage, forecasting models will be designed to minimize MW deviations only if the denominator is a constant (and not a variable such as 'schedule'). This will ensure that the error quantity corresponds to the physical MW impact on the grid, and the error definition holds valid in all seasons.

3.4. Scheduling

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, and hence limit the commercial burden on the generator.

Hence, the schedule of wind and solar generators could be revised by giving advance notice to the SLDC. Such revisions shall be effective from 4th time block, the first being the time-block in which notice was given. There may be one revision for each time slot of one and half hours starting from 00:00 hours of a particular day subject to maximum of 16 revisions during the day.

The plan for data telemetry, formats of forecast submission and other details in this regard should be provided in the Detailed Procedure to be prepared by SLDC and approved by the State Commission.

Any commercial impact on account of deviation from schedule based on the forecast would have to be borne by the wind and solar generator, either directly or transacted via the representing QCA.

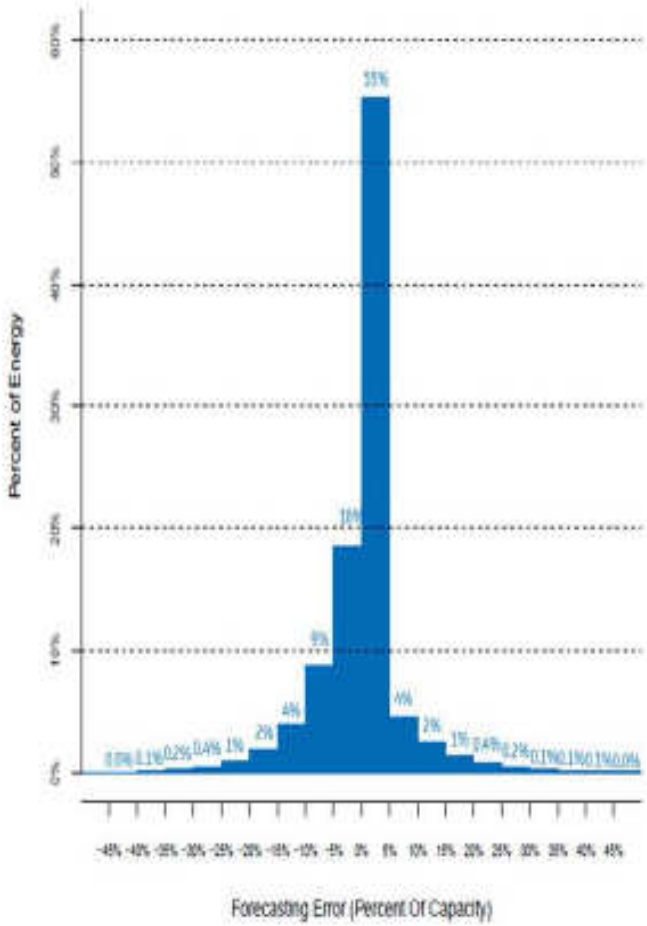
3.5. Deviation Settlement

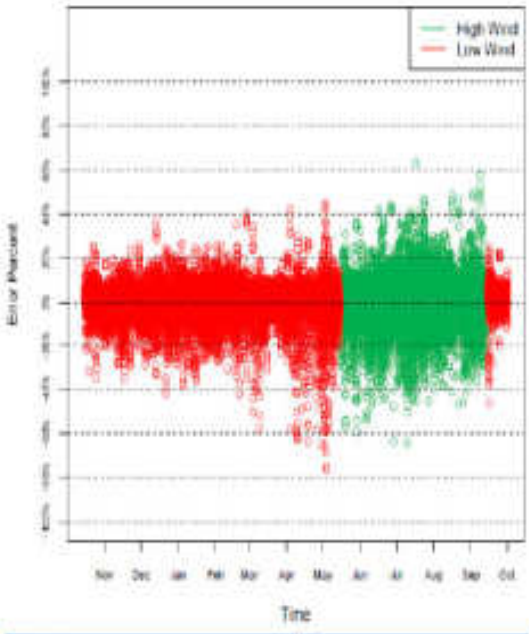
While forecasting accuracy increases over time with improved models and more reliable data, 100% accuracy is not possible to achieve given the uncertain nature of solar and wind sources. However, to incentivize investment in better forecasting methodologies and reliable data, deviation charges would be levied outside a tolerance band. Within this tolerance band, there will be no revenue impact on the 22

generator. However, outside this band, a graded deviation charge can be applied. This will provide incentive to forecast as accurately as possible, utilizing the schedule revisions, and communicate accordingly with SLDC.

Currently, all wind and solar generators are being paid as per actual generation. This could be continued in all cases of 'single seller-single buyer' model, and where power is being sold within the State.

The Central Commission, while proposing the DSM amendments for solar & wind regional entities, considered simulations and analytical inputs from agencies engaged in wind forecasting. For various sites across India, based on one year of actual data, the error normalized to capacity was simulated (pertaining to case where Available Capacity = Installed Capacity). The results were plotted in graphs, a few of which are reproduced from CERC's SOR document below:





Period	MAE
Overall	6.21%
High Wind	8.22%
Low Wind	5.12%

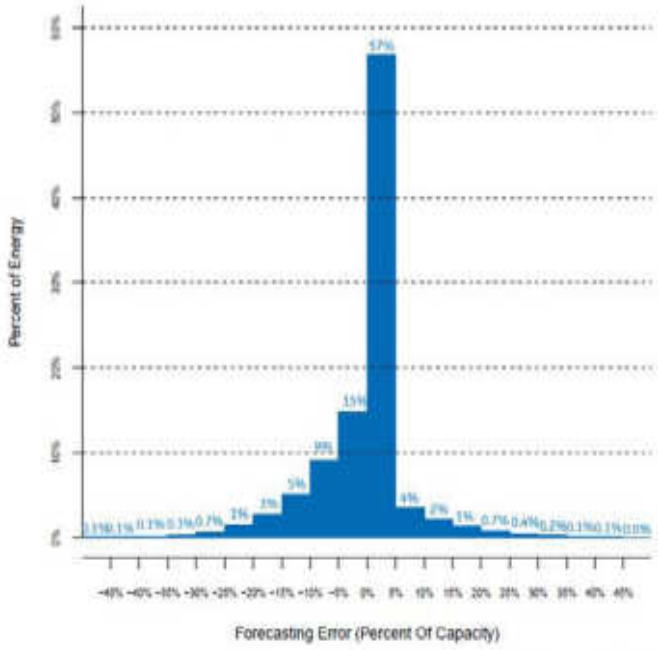
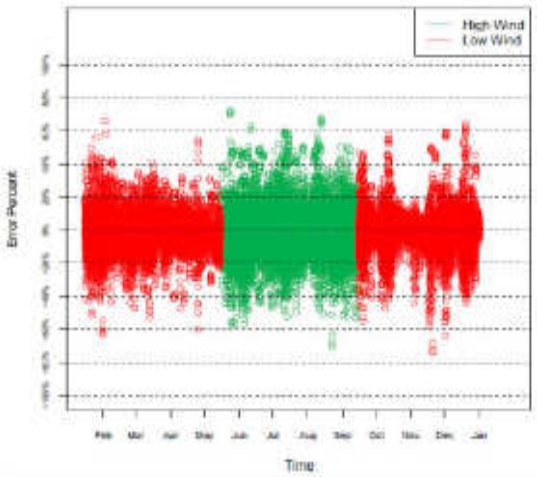
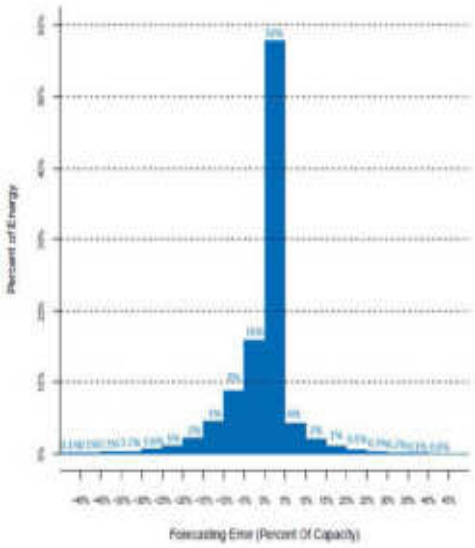


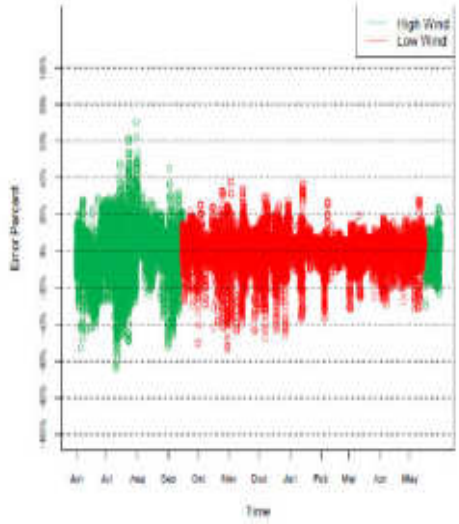
Figure 1: Site A 25.5 MW



Period	MAE
Overall	8.62%
High Wind	10.84%
Low Wind	7.39%

Figure 2: Site B 24 MW





Period	MAE
Overall	7.56%
High Wind	10.71%
Low Wind	5.97%

Figure 3: Site C 72 MW

The first two sets of graphs plot *simulation results* with 16 revisions, based on 50 weeks of actual recorded data, thus including both high wind and low wind seasons. The resulting accuracy is very high. The third plot is a *real-world example* of one year of forecasting algorithm

that was run at the site based on previously allowed number of revisions, i.e. 8 per day. This pilot also reports a fairly high accuracy, with 87% of output energy within +/-10% error, and 94% within +/-15%.

The Central Commission, in view of simulation studies such as above, as well as international research reports on observed MAE, has put forth a framework for computing deviation charges based on error, with a tolerance band of 15% initially, which shall be tightened over time as the ecosystem gains experience. The State Commission proposes the following, with a structure in line with CERC's framework; however, a tighter tolerance band for new projects, as it is felt that with the framework of aggregator (QCA) at pooling station, 10% accuracy (defined w.r.t available capacity) is quite achievable. For existing generators, the framework is more liberal, so as to ensure minimal financial impact on existing PPAs. The COD (Commercial Operation Date) may be considered w.r.t. the date this regulation is notified, to categorize the generators as 'existing' (COD before regulation notification date) or 'new' (COD after regulation notification date).

In the event of actual generation of a generating station or pooling station being less or more than the scheduled generation, the deviation charges for shortfall or excess generation shall be payable by the wind and solar generator or the QCA, as the case may be, to the State DSM Pool, as given in Table – 1 and Table – 2 below:

Table – 1: Deviation Charges in case of under or over-injection for New Generators

Sr. No.	Absolute Error in the 15-minute time block	Deviation Charges payable to State DSM Pool
1	< = 10%	None
2	>10% but <=20%	At Rs. 0.50 per unit for the shortfall or excess energy for absolute error beyond10%
3	>20% but <=30%	At Rs. 0.50 per unit for the shortfall or excess energy beyond 10% and upto 20% + Rs. 1.0 per unit for balance energy beyond 20% and upto 30%

4	> 30%	At Rs. 0.50 per unit for the shortfall or excess energy beyond 10% and upto 20% + Rs. 1.0 per unit for shortfall or excess energy beyond 20% and upto 30% + Rs. 1.50 per unit for balance energy beyond 30%

Table – 2: Deviation Charges in case of under or over-injection for Existing Generators

Sr. No.	Absolute Error in the 15-minute time block	Deviation Charges payable to State DSM Pool
1	< = 15%	None
2	>15% but <=25%	At Rs. 0.50 per unit for the shortfall or excess energy for absolute error beyond 15% and upto 25%
3	>25% but <=35%	At Rs. 0.50 per unit for the shortfall or excess energy beyond 15% and upto 25% + Rs. 1.0 per unit for balance energy beyond 25% and upto 35%
4	> 35%	At Rs. 0.50 per unit for the shortfall or excess energy beyond 15% and upto 25% + Rs. 1.0 per unit for shortfall or excess energy beyond 25% and upto 35% + Rs. 1.50 per unit for balance energy beyond 35%

As in aggregation, the QCA should also de-pool the energy deviations as well as deviation charges to each generator using one of the following options:

- In proportion to actual generated units for each time-block for each generator
- In proportion to available capacity of each generator

RPO accounting can continue as per existing arrangement, and needs no change.

Symmetrical deviation charges around zero ensure that there is no perverse incentive for gaming or mis-declaration of schedule by the generator. Secondly, a tolerance band equivalent to 15% of installed capacity is quite wide, based on some simulations conducted by a couple of stakeholders on CERC's request. This is a good starting point to get the processes ironed out and get the ecosystem disciplined. As experience is gained, this zero-impact band might be tightened in future.

It must be noted that taking cognizance of variable and uncertain nature of these sources, the solar and wind generators have been exempt from the frequency linked deviation charges. The State Pool might be surplus or deficit depending on instantaneous DSM rate when solar or wind generators deviate vis-a-vis the deviation rate applicable on them. The State may then approach a national fund such as PSDF or NCEF in case the State DSM pool goes into deficit due to these regulations. Accordingly, the State shall create accounting procedures to track schedules and actual generation of all generators, including wind and solar generators, as well as deviation charges of solar and wind generators under a separate head, as detailed in Section 4 below.

3.5.1. Case of generator selling power outside the State

The generators connected to the State grid, even if selling power outside the State, will remain under SLDC's jurisdiction. IEGC sub-clause 6.4(1) clearly demarcates responsibilities and control areas:

"The Load Despatch Centre of a control area therefore is responsible for coordinating the scheduling of a generating station, within the control area, real-time monitoring of the station's operation, checking that there is no gaming (gaming is an intentional mis-declaration of a parameter related to commercial mechanism in vogue, in order to make an undue commercial gain) in its availability declaration, or in any other way revision of availability declaration and injection schedule, switching instructions, [meter data processing] , collections/disbursement of UI payments, outage planning, etc. The following clause gives the criteria for demarcation of control area jurisdiction."

Additionally, sub-clause 6.4(2)c(ii) states:

"If a generating station is connected only to the State transmission network, the SLDC shall coordinate scheduling, except for the case as at (a) above."

Thus, IEGC clearly specifies control area jurisdiction for different types of entities. Generators connected to the State network are monitored, metered and controlled by SLDC, even though nature of transaction might change over time (intra-state, inter-state, open-access etc).

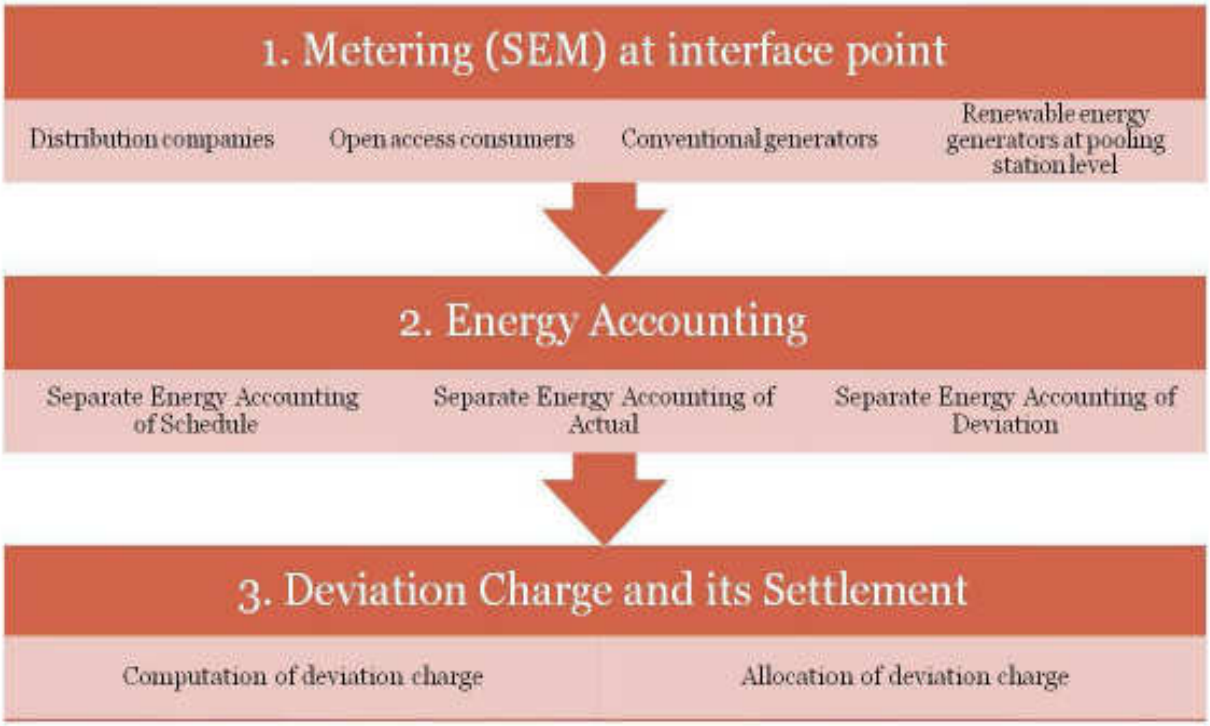
For generators connected to the State grid and selling power outside the State, payment shall be made by the buyer as per schedule, in alignment with existing energy accounting practices at the regional level. This will ensure that wind and solar generators can seamlessly participate in the national market, which would benefit them in the long run. A brief summary of the deviation settlement rules is provided in the Appendix. The Commission underscores that the accounting shall be undertaken by State Load Dispatch Centre, and settlement shall be done with the State Pool. It should be noted that even though payment is made as per schedule, the settlement with the State Pool would effectively provide payment as per actual to the generators. Additional deviation charges shall be applicable if the error is outside the tolerance band.

Additionally, in schedule based payment, RPO is deemed complied on the basis of schedule. However, in case of under-injection for example, there would arise a need for balancing actual RE generation with RPO. This necessitates procurement of equivalent RECs for shortfall in RE generation. Similarly over-injection necessitates crediting REC towards such excess generation. As in the regional framework, all RE shortfalls and over-injections can be netted off (on a monthly basis) for the entire State pool first. In case of RE shortfall, RECs will be purchased by the nodal agency SLDC from exchange by using funds from the State DSM pool and the RECs so purchased shall stand extinguished. In case of RE surplus, notional RECs will be credited to the DSM pool as carry forward for the next cycle.

4. Metering, Energy and Deviation Accounting

While integration of solar and wind generating stations presents unique challenges to grid management, several other mechanisms must be put in place to create a strong foundation for a reliable grid. Separate energy accounting, both for injection schedule as well as drawl schedule, is

essential for ensuring grid discipline from all grid-connected entities, such as DISCOMs, open access consumers, conventional and renewable generators. To achieve this objective, separate metering, schedule preparation, accounting of actual generation/drawl, accounting of energy deviations and deviation settlement shall be undertaken for different types of entities. The complete accounting process will be operationalized in the following manner:

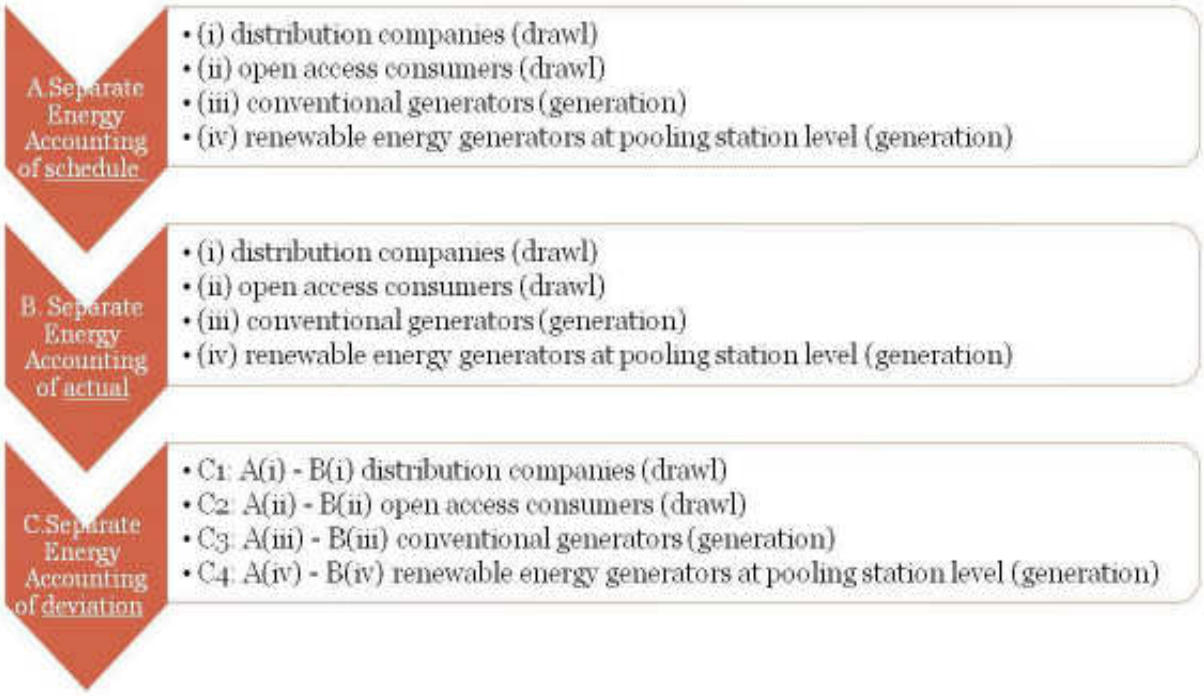


4. Metering:

Interface Metering for intra-state entities shall be undertaken on an urgent basis. Every entity must be metered with a Special Energy Meter (SEM).

5. Energy Accounting

Interface Metering for intra State entities shall be undertaken on an urgent basis. Every entity must be metered with a Special Energy Meter (SEM), and the energy accounting for each such entity shall be done in the following manner:-



As seen from the flowchart above, separate accounting shall be done for schedule, actual and deviations of all grid-connected entities. This will enable SLDC to accurately distribute the State boundary energy deviations (and associated commercial charges to RLDC) among different categories of generators and drawl entities.

6. Deviation Settlement

Deviation settlement for the state shall be governed by the following provisions:

Stage – 1: Transitional Arrangement

3.1 Computation of Deviation Charge

Deviation charges shall be computed in the following manner:-

6.1.1. Deviation Charge (D) payable/receivable for the State as a whole at the State periphery shall first be computed.

6.1.2. Deviation charge (R1) from the pooling stations/RE generators based on these regulations, shall be collected and pooled in the State DSM Pool.

3.2 Settlement of deviation charge

Deviation charge as above shall be allocated to different grid connected entities in the following manner:-

3.3.1 Deviation charge shall be allocated (D) amongst the distribution companies/OA consumers/conventional generators/RE generators in proportion to their respective deviation viz., C1/C2/C3/C4

3.3.2 For RE generators, assuming (i) the share out of State level deviation charge as D4 and (ii) receipt of deviation charge from RE generators (Pooling station) based on the charges for deviation as per the model regulation, as R1 - actual commercial impact for the State as a result of deviation of RE generation would be D4-R1

This amount (D4 - R1 if greater than zero) can be refunded to the State DSM pool from PSDF/NCEF.

Stage – 2: Long-Term Arrangement:

3.4 Computation of Deviation Charge

3.3.1 Compute Deviation Charge (D) payable/receivable for the State as a whole at the State periphery

3.4.4 Implement Deviation Settlement Mechanism(DSM) for conventional generators on lines of CERC DSM or any other variant, that is, determine in advance the deviation charge payable/receivable by all grid connected entities within the state

3.4.5 Implement DSM mechanism for RE generators on lines of model regulation and collect in the State DSM pool, deviation charge (R1) from the pooling stations/RE generators based on the said model

3.5 Settlement of deviation charge

3.4.1Compute for the distribution companies/OA consumers/conventional generators, the deviation charges payable/receivable by them in proportion to their respective deviation viz., C1/C2/C3 (this should be as per State level DSM)….(assume net balance as D1)

3.5.2 In respect of RE generators, collect deviation charge from the RE generators (Pooling station) based on the charges for deviation as per the model regulation (assume as R1)

3.5.3 Actual commercial impact for the State as a result of deviation of RE generation would be D4-R1

If D is greater than (D1+R1), the differential be made good from the PSDF/NCEF

The Commission directs the Staff to prepare relevant regulations, or amendments to existing regulations, to put in place procedures described above latest by April 1st, 2016.

5. Conclusion

The proposed framework deals with operational and commercial aspects of running wind and solar generating units on the grid. This regulation is a big first step for the State grid operator to be able to manage the variable power effectively. The Central Government's initiative towards facilitating centralized forecasting through establishment of Renewable Energy Management Centres (REMCs), co-located with SLDCs, is expected to help in capacity building at SLDCs, as well as development of better forecasting and more accurate scheduling methods. Notwithstanding the issue of forecasting accuracy that is feasible, the next natural issue to address is that of balancing. The deviation from schedule is inevitable for RE generators as 100% accuracy is not possible to achieve, even with frequent revisions. To manage these uncertain deviations in real time, the grid operator must have access to reserves. The Commission directs its staff to work on Ancillary Services Regulations, including spinning reserves. Both primary and secondary reserves will assist the SLDC to maintain load-generation balance, and ensure grid reliability. Fast ramping resources such as pumped hydro or natural gas plants are natural options to be deployed for balancing. Backing down of thermal units will also be necessary.

As stated above, the State shall create accounting and settlement procedures to keep records of time-block wise schedules, actual generation and deviations for all generators, including wind and solar generators. Once this is put in place, all RE generators can be treated together as a virtual pool within the State Pool. Deviations for and within this virtual pool could be settled first at the rates and methodology

stipulated above for wind and solar generators. This aggregation at the State level will be advantageous, reducing the impact on the State as well as the generators. Annual accounts as mentioned above shall be prepared by the SLDC. In case there is deficit in the overall pool at the end of the year, then the SLDC may approach the National Funds such as PSDF or NCEF to cover such deficit. This facility of support from the National level fund for meeting the deficit is expected to be available till 31.3.2019 as recommended by the Forum of Regulators.

Appendix: Framework for deviation settlement of wind or solar generator, or QCA on their behalf, connected to the State Grid and selling power outside the State boundary

The wind or solar generator, or QCA on their behalf, shall be paid as per schedule for a time-block. The error shall be defined w.r.t Available Capacity (AvC). If there is a deviation from schedule, the deviations shall be settled as below:

- If the Absolute (Abs) Error is less than 15%: no deviation charge shall be applicable on the generator. If the generator has under-injected (vs schedule given), the generator shall return to the State pool amount equivalent to (no. of units under-injected) x (PPA rate). On the other hand, if the generator has over-injected (vs schedule given), the generator shall receive from the State pool an amount equivalent to (no. of units under-injected) x (PPA rate). Thus, the net revenue of the generator within this tolerance band is equivalent to revenue as per actuals.
- If the Abs Error is greater than 15% but less than 25%: the generator shall settle the difference with respect to schedule, with the State pool at its PPA rate, as above. In addition to this settlement, the generator would pay a deviation charge calculated as follows:

Deviation charge (I) = (no. of units outside 15% of AvC) x (10% of PPA rate)

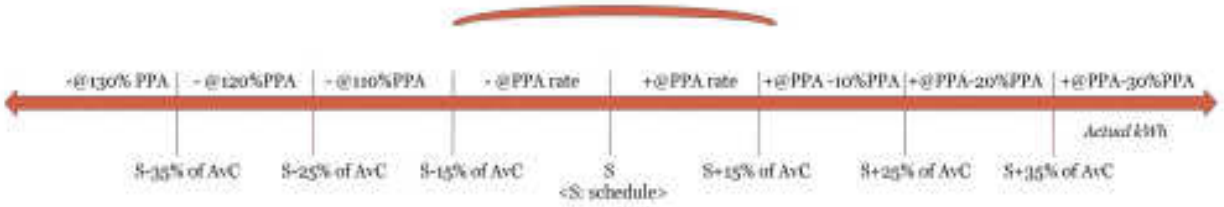
- If the Abs Error is greater than 25% but less than 35%: the generator shall settle the difference with respect to schedule with the

State pool at its PPA rate. In addition to this settlement, the generator would pay a deviation charge calculated as follows:

Deviation charge (I) = (10% of AvC) x (10% of PPA rate) Deviation charge (II) = (no. of units outside 25% of AvC) x (20% of PPA rate) Total deviation charge in this case = Deviation Charge (I) + Deviation Charge (II)

- If the Abs Error is greater than 35%: the generator shall settle the difference with respect to schedule with the State pool at its PPA rate. In addition to this settlement, the generator would pay a deviation charge calculated as follows:

Deviation charge (I) = (10% of AvC) x (10% of PPA rate) Deviation charge (II) = (10% of AvC) x (20% of PPA rate) Deviation charge (III) = (no. of units outside 35% of AvC) x (30% of PPA rate) Total deviation charge in this case = Deviation charge (I) + Deviation charge (II) + Deviation charge (III) Pictorially, this framework can be represented as follows (AvC: Available Capacity):



The PPA rate mentioned above which shall be used for the purpose of Deviation Settlement shall be the PPA Rate as determined by the Appropriate Commission under Section 62 or as adopted under Section 63 of the Electricity Act 2003 through a separate order. In case the RE generator has multiple PPAs at different rates, then the weighted average PPA rate shall be used for the purpose of Deviation settlement. On the issue of Settlement for Open Access (OA) users and Captive Power Plants (CPPs), it has been felt that Settlement of OA (REC projects) and CPP poses a challenge, particularly for CPP where there is no PPA rate. All deviations from schedule by these entities must be settled at National APPC rate, as determined by CERC from time to time.