DISCUSSION PAPER

ON

DETERMINATION OF GENERIC TARIFF FOR GRID CONNECTED ROOF-TOP SOLAR PV

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Discussion paper on determination of generic tariff for grid connected roof-top solar PV

1. Introduction

1.1 The Commission has recently notified WBERC (Co-Generation and Generation of Electricity from Renewable Sources of Energy) (first Amendment) Regulations 2020 vide Notification No. 71/WBERC dated 21.12.2020 [RE First Amendment].

1.2 In the RE First Amendment it is specified that eligible consumers having sanctioned load /contract demand upto 5 kW may set up solar PV system under Net Metering arrangement and eligible consumers, except agriculture consumers, having sanctioned load /contract demand above 5 kW may set up solar PV system under Net Billing arrangement. All eligible agriculture consumers may set up solar PV under Net Metering Arrangement.

1.2.1 Under the Net Metering Arrangement, the energy injected by the solar PV system of the customer into the distribution network of the licensee gets adjusted to the maximum extent of 90% against the drawal of energy by the consumer from the grid. The balance unadjusted injection of energy by the Solar PV System, if any, is carried forward to the next billing period. This process of adjustment will be continued for the entire financial year. At the end of the financial year, after effecting the final adjustment for that month, surplus injection from Solar PV system will be treated as unwanted / inadvertent injection.

1.2.2 Under Net Billing arrangement, the energy generated from solar PV is purchased by distribution licensee at generic tariff and distribution licensee raises the bills on the consumer for his consumption at approved retail tariff, after giving credit for total electricity sold out to the distribution licensee. In case, the value of sold out solar energy (energy X generic tariff) is more than the consumer's electricity bill in a particular month, the balance will be carried forward as Billing Credit up to the end of the Financial year. At the end of Financial year, if there is any outstanding Billing Credit, the same shall be treated as NIL by the distribution licensee.

1.3 In RE First Amendment, to promote the small scale solar-PV projects in the State, under the proviso of regulation 5.3 it is specified that, distribution licensee can purchase power from grid-connected solar projects below the notified capacity for competitive bidding located within the State within the limit of feed-in-tariff to be notified from time-to-time.

1.4 Thus, for implementation of these new provisions of the RE First Amendment Regulations followings are required:

A. In terms of paragraph (2) of Schedule -2 of RE First Amendment, the Commission has to specify generic tariff in respect of roof-top solar-PV plants for net-billing purpose.

B. In terms of regulation 5.3 of RE First Amendment, the Commission has also to notify feed-in tariff for solar projects located within the State having capacity below the notified capacity for competitive bidding.

2. Relevant provisions of Electricity Act 2003 and Tariff Policy framed thereunder:

2.1 **Electricity Act 2003:** Clause (h) of section 61 of the Act specifies that, determination of Tariff shall inter-alia be guided by the principle of promotion of co-generation and generation of electricity from renewable sources of energy.

2.2 **Tariff Policy 2016**: The Tariff Policy 2016 envisages all renewable power procurement through competitive bidding except from waste to energy plant. Relevant portion of the Tariff Policy under sub-paragraph (2) of paragraph 6.4 is reproduced below:

> "States shall endeavour to procure power from renewable energy sources through competitive bidding to keep the tariff low, except from the waste to energy plants. Procurement of power by Distribution Licensee from renewable energy sources from projects above the notified capacity, shall be done through competitive bidding process, from the date to be notified by the Central Government."

Pursuant to the Tariff Policy, Government of India has notified Competitive bidding guidelines on 03.08.2017 for procurement of power from grid connected solar PV power projects having size of 5 MW and above.

Thus, for solar plant with capacity below 5 MW appropriate commission is required to determine the related tariff.

2.3 **Approach adopted by different ERCs:** It is observed that, some of the SERCs have determined generic tariff for roof-top solar-PV based on normative CAPEX, debt-equity ratio, normative O&M and Capacity Utilisation Factor (CUF). CERC in its RE Tariff Regulations 2020 decided to determine project specific solar tariff on case to case basis. States like Maharastra, Gujarat in their recent notifications have relied on the price discovered in the bidding process to arrive at generic tariff for solar-PV based projects.

3. Feed-in-tariff (FIT) design approach:

3.1 The expected demand of West Bengal is 57168 MU in 2021-22. Out of this, 4.5% of the demand remaining after subtracting the hydro energy available from conventional hydro sources (not small hydro) is required to be met from solar generation as per the RPO(Solar) trajectory specified in the RE First Amendment Regulations 2020. At present development of solar power is not taking place in West Bengal at the desired pace. As on date, total RE capacity in West Bengal is 500+ MW whereas In the National Electricity Plan, MNRE had projected that, by March,2022, the total installed capacity of solar plants alone in the state should be 5336 MW. West Bengal is lagging far behind the capacity addition target. Even to match the moderate solar target specified in the RE First Amendment, distribution licensees in the State will have to purchase power from outside the State, the cost of which will be discovered through competitive bidding or through power exchange. The landed cost of power at consumer end shall normally include STU losses and charges, and distribution losses and charges. Therefore, there is an urgent need to bring in FIT Policy in order to stimulate the rapid development in Solar Power in the state.

3.2 Feed-in-Tariff (FIT) design is very challenging, to say the least. Internationally several options like cost-plus approach, variable premium approach, avoidance cost approach, market clearing price approach etc. have been experimented. Every approach though has its own limitation and advantages.

3.3 While making the tariff design, the challenge is to set the FIT appropriately. If the tariff is too high, this may lead to windfall profit to the investors. If the tariff is too low, very few investors will be willing to come forward to invest.

3.4 The best design principle would be to keep it simple, transparent and constant over the years. Any change in-between creates uncertainty and investors may perceive it as a risk. Constant FIT over the whole life cycle of the project is a desirable solution, although it may bring some distortion in electricity market. However, a constant tariff per kWH for the entire life of the plant mitigates the risk of the investors. As such, financing cost also comes down significantly. The international experience shows that a constant FIT can stimulate rapid development of RE capacity addition.

3.5 In India, the cost-plus approach was practiced successfully for a long time to determine the FIT for solar plants. The approach has some inherent benefits - it is equitable, predictable, transparent in determination of tariff and gives an assured return to the investor. However, FIT greatly varies with technology, size of the project, location of the projects, etc. On the contrary, in recent years our country has witnessed a rapid fall in solar tariffs discovered through competitive biddings, mainly due to rapid change in technology and scale of economy. The lowest ever bid so far was recorded in December 2020 at 1.99 Rs./kWh.

3.6 Thus, in order to capture the benefit of rapidly changing technology in large scale solar projects as well as to ensure the investments of small consumers through roof-top solar-PV, it is found suitable to consider following two approaches based on the installed capacity:

(A) Feed-in-tariff for MW scale solar-PV (i.e 1 MW to less than 5 MW) to be based on the tariff discovered under competitive biddings along with premium to encourage solar projects in the State.

(B) Generic tariff for kW scale solar-PV (i.e less than 1MW) to be determined under cost plus approach.

Any purchase by distribution licensee from solar-PV projects of 5MW and above will be only through competitive bidding route following the guidelines issued by Government of India.

3.7 Now technological innovations are taking place rapidly in RE. This is having a huge cost implication. So, FIT needs to be revisited at fixed interval of time. FIT once determined shall be valid for the projects which comes within a specific period of time, say one or two years. The projects coming thereafter shall have new FIT which shall be determined taking into consideration all relevant factors including technological innovation at that time.

3.8 FIT / generic tariff so arrived at may be recovered at a constant rate throughout the life of the project by way of levelized tariff. Alternatively, instead of fixed rate, digression techniques are used

where the tariff over the year decreases at a constant rate. In some options, inflation has been factored which results in increase of FIT tariff over the years

4 Feed-in-Tariff for MW scale solar-PV projects

4.1 in order to capture the benefit of rapidly changing technology in the sector it is proposed to determine the FIT of MW scale solar-PV projects (less than 5 MW) based on tariff discovered under competitive biddings.

4.2 Now it is required to identify to what extent the discovered price under competitive biddings in the country could be related to the plants with less than 5 MW capacity to be located in the State.

4.2.1 Price discovered under competitive biddings are for solar projects above 100 MW, which are not practically comparable to the small MW scale projects below 5MW. Further, majority of solar projects coming through competitive biddings are located in Southern or Western part of the Country, where solar irradiance is much higher compared to that of West Bengal. Thus, such tariff may not match the investors' comfort in West Bengal since recovery elsewhere is higher once CUF is higher with higher irradiance.

4.2.2 As discussed above, solar installations in West Bengal is still very low than the required level and thus to meet the solar RPO, distribution licensees in the State will have to purchase a large quantum of such power from outside the State. Even if such procurement is done through competitive bidding, the landed cost will normally include Transmission charges and losses to arrive at the distribution licensees' boundary.

4.2.3 Under these circumstances, it is found prudent to fix the feed-in tariff for solar projects located in the State with installed capacity less than 5 MW at a price equivalent to the landed cost of competitive bid at Distribution Licensees' boundary topped up with a premium. This will provide a preferential rate to such small solar projects to make up their cost due to lower CUF in the State. At the same time consumers of the licensees will get benefit similar to the power purchased under competitive bidding tariff from outside the State.

4.3 Thus, for FIT determination purpose, the average of Competitive based tariff of solar plants adopted by CERC in the last financial year [2019-20] can be considered as benchmark value and the feed-in-tariff could be determined as below:

- Average Competitive bid tariff of solar plants adopted by CERC in the last financial year may be considered as a base. [Rs 2.53 /kWh for FY 2019 -20 as in Annexure -A1]
- A premium of 5% over the average competitive bided tariff;
- CTU charge and CTU loss at present considered as zero.
- Applicable STU charge and STU losses
- Applicable distribution loss

4.4 The proposed feed-in-tariff for 2020-21 comes to Rs. 3.00 / kWh as below:

Sl No	Particulars	Rs/kWh

1	Avg of CERC adopted tariff for solar u/s 63 during 2019-20	2.53
2	Admissible premium of 5%	0.13
3	STU charge (avg rate: 2019-20)	0.24
4	Sub-total	2.81
5	At Distribution boundary (3.4% STU loss)	3.00

5. Generic tariff for KW scale roof-top solar-PV under net-billing:

5.1 It is envisaged that a cost-plus approach for determination of generic tariff for kw scale solar PV system under Net Billing would balance the interest of the investor as well as the licensee. The investor is having a guaranteed return on his Investment along with full recovery of cost. It has been estimated that the weighted average rate of generic tariff based on the above principle will be lower than the average power purchase cost of the distribution licensee. This will benefit the licensee also. So this will be a win-win situation for investor as well as licensee.

5.2 It is proposed to adopt the following parameters for determination of generic tariff for kW scale grid connected roof-top solar PV under net-billing:

(i) Life of the Plant: In line with CERC RE Tariff Regulations, useful life of solar project is considered as 25 years.

(ii) Capacity Utilisation Factor (CUF) has been considered as 17% in line with the minimum CUF allowed under Tariff Based Competitive bidding by SECI.

(iii) Normative Capital expenditure (CAPEX) for KW level roof-top solar is considered as per the latest benchmark specified by MNRE office memo no 318/38/2018-GCRT dated 21.07.2020 for FY 2020-21 as below:

Capital cost for projects above 1kW : Rs 47000 per kWp
Capital cost for projects above 1kW to 2 kW : Rs 43000 per kWp
Capital cost for projects above 2kW to 3 kW : Rs 42000 per kWp
Capital cost for projects above 3kW to 10 kW : Rs 41000 per kWp
Capital cost for projects above 10kW to 100 kW : Rs 38000 per kWp
Capital cost for projects above 100kW to 500 kW : Rs 36000 per kWp

Capital cost for projects above 500 KW but less than 1MW is considered same as that of 500 kW, in absence of specific benchmark cost.

(iv) Normative Debt equity ratio of 70:30 is considered.

(v) Rate of Return on Equity has been considered as 14% in line with CERC RE Tariff Regulations, however no effect of tax gross-up is provided for kW scale roof-top solar-PV plants under net-billing.

(vi) Interest and tenure of debt: It is observed that commercial banks are providing solar loan for 15 years tenure broadly in line with CERC. It is further observed that, long-term interest on

solar loans by leading commercial banks varies from 7.20% to 9.70%. [PNB offers 8.35% with 30 to 50 bps, SBI offers MCLR rate plus 20 to 50 bps, IREDA offers (Grade-I: 9.70% to Grade-V: 10.85%)]. Thus, an average interest rate of 8.52% is considered for generic tariff determination purpose.

(vii) Depreciation: It is proposed to allow depreciation upto 90% of the Asset value. To ensure loan repayment (70% of CAPEX) within 15 years (loan tenure) depreciation rate of 4.67% is proposed for first 15 years. Balance depreciation is evenly spread during remaining useful life of the plant.

(viii) O&M expenses: There are various literature regarding O&M expense for solar-PV projects, which ranges from Rs. 300 /kWp to Rs. 600 /kWp per annum. For determination of generic tariff O&M expense of Rs. 450/kWp is considered. The benchmark CAPEX specified by MNRE includes O&M expense for initial 5 years. Thus O&M cost of Rs. 450/kWp will be applicable from 6th year of operation with an annual escalation of 3.84%.

(ix) Working Capital Interest: In line with WBERC Tariff Regulations, it is proposed to consider normative Working Capital requirement @ 18% on annual fixed cost reduced by depreciation and ROE. Working Capital interest is proposed at MCLR rate of SBI as on 1st April of the year preceding the year for which tariff is being determined, i.e. on 01.04.2019 (8.20%).

(x) No degradation factor for kW scale solar roof-top plant is considered. Auxiliary consumption for kW scale solar roof-top is considered as nil.

(xi) Tariff design: It is proposed to determine generic tariff on levelized basis considering the year of commissioning of the project. For the purpose of this levelized tariff a discount factor equivalent to weighted average cost of Capital is considered, which comes to 10.16% [8.52% X 0.7 + 14.00% X 0.3].

5.3 Considering the normative parameters mentioned above the generic tariff for kW scale roof-top solar is determined as below:

Capacity	Levelized tariff
1 Kw	Rs. 3.94 /kWh
Above 1kW to 2 kW	Rs. 3.62 /kWh
Above 2 kW to 3 kW	Rs. 3.54 /kWh
Above 3 kW to 10 kW	Rs. 3.46 /kWh
Above 10 kW to 100 kW	Rs. 3.23 /kWh
Above 100 kW to 500 kW	Rs. 3.07 /kWh
Above 500 kW but less than 1MW	Rs. 3.07 /kWh

However, for installations of 1 MW and above solar pv system under net-billing arrangement, the generic tariff is proposed to be similar to feed-in tariff for MW scale projects i.e. Rs 3.00 /kWh.

5.4 The above computed generic tariff is well below the average landed price of conventional power purchased by licensees in the State including their own generation. Thus, it will not be a burden for

Distribution licensee, moreover such distributed solar generation will help the licensee to reduce their transmission and distribution losses.

5.5 Further an analysis considering the generation from roof-top solar-PV (with 17% CUF) and the proposed generic tariff shows that it will provide sufficient incentive to the consumers installing solar-PV plant under net-billing as below:

Particulars	Capital Investment per kW	Annual estimated generation per kW installed capacity#	proposed generic tariff	Annual savings in electricity bill ## (against per KW capacity)	Income from capital	Average monthly savings (against per kW capacity)	EMI on 70% Capital for 15 years (per kW capacity)
	Rs.	kWh	Rs. / kWh	Rs.	%	Rs	Rs
above 3 kW to 10 kW	41000	1489.20	3.46	5153	12.57%	429	283
above 10 kW to 100 kW	38000	1489.20	3.23	4810	12.66%	401	262
above 100 kW but less than 1MW	36000	1489.20	3.07	4572	12.70%	381	248

Note: # considering 17% CUF;
subject to other provisions under RE First Amendment Regulations.

6. Conclusion:

Based on the above followings are concluded:

(i) Generic tariff for net-billing specified in paragraph (2) of Schedule -2 or feed-in tariff required under regulation 5.3 of RE First Amendment, is essentially tariff for solar-PV power purchased by distribution licensee. The only difference is that, under net-billing mechanism the cost is adjusted with consumer's electricity bill and feed-in tariff will be applied for purchase of solar power from solar plants below 5 MW capacity located in the State. Thus, it is required to ensure that, tariff shall reflect the cost of generation as well as market price and at the same-time does not impose much burden on the distribution licensee.

(ii) Generic tariff for net-billing purpose:

- For installed capacity 1kW : Rs. 3.94 /kWh
- For installed capacity above 1 kW to 2 kW : Rs. 3.62 /kWh
- For installed capacity above 2 kW to 3 kW : Rs. 3.54 /kWh
- For installed capacity above 3 kW to 10 kW : Rs. 3.46 /kWh
- For installed capacity above 10 kW to 100 kW : Rs. 3.23 /kWh
- For installed capacity above 100 kW but less than 1MW : Rs. 3.07 /kWh
- For installed capacity 1 MW and above : Rs 3.00 /kWh

(iii) **Feed-in Tariff for purchase from solar plants within the State, not covered under competitive bidding (i.e. 1 MW and above but below 5 MW)**

- Rs. 3.00 /kWh

(iv) Distribution licensee shall purchase power from solar projects of 5MW and above through competitive bidding only.

(v) Feed-in-tariff and generic tariff determined by the Commission will continue for two year and once agreed between the licensee and power plant / consumer, the tariff will be constant for the entire useful life of the respective plant.

(vi) Roof-top solar installation is in a very nascent stage in the State. Thus, availability of State specific information is very limited. Technology is also changing rapidly. After two years with further experience gathered in the State, Commission may review the approach and redetermine the rate(s) accordingly.

Annexure-1

- **CERC Adopted Tariff U/s 63 for Solar PV Projects during 2019 - 20**

CERC Order No	CERC Order date	Petitioner	Project Name	Successful Bidders	Quantum Allocated	Adopted Tariff U/s 63
					MW	Rs/kWh
204/AT/2019	20.11.2019	SECI	Tanche III (ISTS)	ReNew Solar Power Private Limited	300	2.55
				Azure Power India Pvt. Ltd	300	2.58
				Eden Renewable Cite (P) Ltd.	300	2.60
				SBSR Power Cleantech Eleven (P) Ltd.	600	2.61
57/AT/2020	24.02.2020	NTPC	-	SB Energy Six Private Limited	600	2.60
396/AT/2019	26.02.2020	SECI	Tranche II	ACME Deoghar Power Private Limited	300	2.44
				ACME Dhaulpur Power Tech Private Limited	300	2.44
187/AT/2019 and IA No. 86/2019	28.02.2020	TPDDL/ SECI	-	ACME Solar Holdings Limited	600	2.44
				Shapoorji Pallonji Infrastructruee Capital Company Private Limited	250	2.52
				Hero Solar Energy Private Limited	250	2.53
				Mahindra Susten Private Limited	250	2.53
				Azure Power India Pvt. Ltd	600	2.53
				Mahoba Solar (UP) Private Limited	50	2.54
Average Tariff for 2019 -20						**2.53**