

**KARNATAKA ELECTRICITY REGULATORY COMMISSION**

27.05.2010

**“DISCUSSION PAPER ON DETERMINATION OF TARIFF FOR GRID  
CONNECTED SOLAR POWER PLANTS IN KARNATAKA”  
(Applicable to other than demonstration projects)****1. Background:**

Section 61(h) of the Electricity Act 2003 provides that, while specifying the terms and conditions of determination of tariff, the Commission shall be guided by the objective of promotion of co-generation and generation of electricity from renewable sources of energy. Section 62(1)(a) provides for determination of tariff for supply of electricity by a generating company to a distribution licensee.

Clause 5.12.1 & 5.12.2 of the National Electricity Policy issued by Ministry of Power, Government of India on 12<sup>th</sup> February 2005 envisages promotion of generation of electricity from non-conventional energy sources, biomass and cogeneration.

Clause 6.4 of the Tariff policy issued by Ministry of Power, Government of India on 6<sup>th</sup> January 2006 also emphasizes the need to give preferential tariff for renewable sources of energy.

The Ministry for new and renewable energy (MNRE) vide its guidelines issued in January 2008 for Grid interactive Solar PV Power generation projects and guidelines issued in March 2008 for Grid interactive Solar Thermal Power generation projects provides for generation based incentives. The Ministry of New and Renewable Energy, Govt of India, vide Resolution dated 11<sup>th</sup> January 2010, has launched the “Jawaharlal Nehru National Solar Mission” with an objective to establish India as a

global leader in solar energy, by creating the policy conditions for its diffusion across the Country as quickly as possible. The 'Jawaharlal Nehru National Solar Mission' envisages to ramp up capacity of grid connected solar power generation to 1000MW within 3 years i.e., by 2013, additional 3000MW by 2017 through mandatory use of renewable purchase obligation by utilities backed with a preferential tariff and reach 20,000 MW installed capacity of solar power by the end of the 13<sup>th</sup> Five-year plan in 2022.

Under the generation based incentive scheme of MNRE, the Commission has already issued tariff order on 26.11.2008 for grid connected demonstration solar plants in the state.

Studies conducted by various agencies indicate that, the State has huge solar energy potential and the same needs to be harnessed in the days to come. Solar energy is naturally available at no cost and the power plants (Solar PV) require comparatively low maintenance cost though capital investment in the beginning is high. There is encouraging technology development in the field of solar power generation. Establishment of solar power plants will be able to provide distributed generation and this will minimize the Technical line losses. KPCL has already taken the lead in this direction and has commissioned two solar power plant units of 3MW each at Yelesandra in Kolar District and Itnal village in Belgaum District and has connected to the State grid and a third unit of 3MW in Raichur District is to be commissioned. It is noted that, some private developers have also proposed to setup solar power plants in the State.

The Government of Karnataka, in its Renewable energy policy dated 19.01.2010 and corrigendum dated 06.05.2010, has envisaged a capacity addition of 126 MW of solar power in the next five years. The Policy also envisages installation of roof top solar panels of 5KWp to 100KWp capacity to be connected at 11kv and LT distribution system. The GoK, vide its Order dated 10.05.2010, has also designated KREDL as competent authority to issue certificate required for registering the projects

with IREDA and review and report on the progress of these projects to the Central Government.

In the light of the above, the Commission proposes to circulate this discussion paper on determination of tariff for grid connected solar power plants which are not covered by generation based incentive scheme proposed by MNRE to invite comments/suggestions from all stakeholders.

## **2. Determination of Tariff for the Solar Thermal and Solar Photovoltaic Power projects which are not covered under generation based incentive scheme proposed by MNRE:**

Power generation from solar energy could be either through solar thermal or solar photovoltaic technology. Each of these has various technological options available and new technologies are evolving. The Commission observes that the associated cost, efficiency and performance of such variants could be different and determination of tariff considering each technological option would be a complex and impractical, at least for the present. Therefore, the Commission proposes to determine a generic tariff for solar thermal and solar photovoltaic power generation irrespective of technology adopted by the developers.

### **I. Common Issues:**

The following are the common issues to be decided in the determination of tariff:

#### **(i) Tariff to be single part or two part:**

Since there is no significant variable cost and solar plants are capital intensive, the Commission proposes to adopt a single part tariff for all grid connected solar power plants.

**(ii) Factoring of Incentives allowed by the Government in tariff computations**

The Commission proposes not to factor in the incentives/subsidies, if any, for tariff Computations as a promotional measure. However, this proposed Order is for Solar Power Plants other than those covered under demonstration projects eligible for incentives from MNRE.

**(iii) Sharing of Clean Development Mechanism (CDM) benefits-**

The Central Electricity Regulatory Commission (CERC), in its Regulations dated 16.09.2009, has introduced sharing of CDM benefits as detailed below:.

- a) 100% of gross proceeds on account of CDM benefit are to be retained by project developer in the first year after the date of commercial operation of the generating station,
- b) In the second year, the share of beneficiaries shall be 10%, which shall be progressively increased by 10% every year till it reaches 50%, where after, the proceeds shall be shared in equal proportion by the generating companies and the beneficiaries.

According to the CERC, the above mechanism of sharing CDM has been incorporated after taking into consideration the stipulations made in the Tariff Policy, recommendations by the Forum of Regulators in its Report on Policies for Renewable Energy and similar provisions in the Tariff Regulations for conventional power.

The Commission proposes to adopt the same for solar power plants.

**(iv) Wheeling charges, Surcharges, Banking in the case of third party sales-**

For the third party sale of the energy generated through the solar sources of energy, the Commission proposes to encourage use of solar energy and not to charge any transmission or wheeling charges on solar energy for transactions within the State.

**(v) Merit Order Dispatch**

For the present, as solar power is considered as infirm power, the Commission proposes not to apply Merit order dispatch for all grid connected solar power plants, as a promotional measure.

**(vi) Common Financial Parameters:**

In respect of the following financial parameters, which are common to all the categories of renewable sources of generation, the Commission has proposed to apply them uniformly for all renewable sources including solar power generation.

**(a) Debt Equity Ratio (DE Ratio):**

The Commission proposes to adopt Debt Equity Ratio of 70:30.

**(b) Return on Equity (RoE)**

The Commission proposes to provide a RoE of 16% and to allow actual tax as a pass through as tax rates keep on varying.

**(c) Interest on Term Loan:**

The Commission proposes to consider the interest rate of 11.75% on term-loans following the existing SBI PLR.

**(d) Depreciation:**

The Commission proposes to provide 7% depreciation per annum on straight-line method on the capital cost of the asset, for all the renewable energy projects for the first ten years.

**(e) Minimum Alternative Tax (MAT):**

The Commission proposes to allow Income tax, surcharge & cess as a pass through without factoring in the same for tariff computations. The amount of tax, surcharge & cess that has to be claimed, shall be worked out considering the amount of RoE approved by the Commission. The tax rate [including surcharge & cess] prevailing in the relevant years shall be claimed separately from the ESCOMs.

**II . Specific Issues applicable to Grid connected solar energy projects:**

The following issues, which are specific to the Solar power projects, such as, life of the plant, project cost, Capacity utilisation factor (CUF), O & M Cost, auxiliary consumption etc. are discussed below:

- a. **Life of the plant:** CERC in its Regulations dated 16.09.2009 has considered the useful life of solar plants as 25 years. GERC has also considered 25 years as the useful life of the plant. KPCL in their petition-dated 16.04.2010 and M/s Solitaire Powertech Pvt Ltd in its petition-dated 09.04.2010 have considered the useful life as 25 years.

The Commission proposes to consider the life of the plant as 25years.

b. **Term & Tariff Design:**

The term of the tariff could be for the life of project i.e., 25 Years. M/s Solitaire Power Tech Pvt Ltd has suggested that the term of tariff be 25 years. The term of tariff could either be for 10 yrs or 25 yrs. The purpose of the tenure of tariff is to build in certainty of revenue flows to the generator and to enable the investor to recover his costs.

As regards the type of tariff, it could be average tariff or levelised tariff. The average tariff provides the arithmetic average of the tariff determined for each

year of the term considered for tariff determination, whereas, the levelised tariff considers time value of money for the period of tariff determination.

In order to encourage power generation using solar power, the Commission proposes to consider levelised tariff with a period of 25 years.

**c. Capital Cost:**

Solar power projects in India are at a nascent stage. Definite data on the capital cost is still not available. The Commission, at present proposes to examine the data as per orders of CERC / other Commissions wherein tariff for solar power projects have been determined. M/s Millennium Synergy Pvt Ltd, vide their letter dated 20.08.2009 and Kotak Urja Pvt Ltd, vide their letter dated 22.02.2010 have suggested to the Commission to consider a capital cost of Rs. 18 Crs per MW. As per KREDL letter dated 05.08.2008, the developers have indicated capital cost ranging from Rs. 19.2 Crs to Rs. 25 Crs per MW. The following table indicates the capital cost adopted by other Commissions for determining solar tariff:

<b>Name of the Commission</b>	<b>Rs Lakhs per MW</b>	
	<b>Solar PV</b>	<b>Solar Thermal</b>
CERC	1700	1300
GERC	1650	1300

M/s Solitaire Powertech Pvt Ltd has requested to consider a capital cost of Rs. 16.90 Crs per MW. KPCL has requested to consider the capital cost as Rs. 20.68 Crs per MW. Further, it is reported that M/s Moser Baer has completed a 1MW project in Chandrapur in Maharashtra State at a cost of Rs. 12.50 Crs. In the light of the above, the Commission proposes to consider the capital cost at Rs 1300 Lakhs per MW for both Solar PV plants and Solar thermal plants.

d. **Tenure of Debt:**

The tenure of debt is related to repayment of loan. CERC, in its Regulations dated 16.09.2009, has considered tenure of debt as ten years. Solitaire Powertech have requested to consider 20 years as tenure of debt. KPCL has sought 10 years tenure.

Considering the normative loan repayment period, it is proposed to consider a period of ten years as tenure of debt.

e. **Capacity Utilization Factor:**

Capacity utilization refers to the extent of use of the installed productive capacity. Capacity Utilization factor (CUF) refers to the relationship between actual output that 'is' produced with the installed equipment and the potential output, which 'could' be produced with it, if capacity was fully used on an annual basis.

CERC, in its statement of reasons and objects on regulations for renewable energy, has noted that there are 290 to 320 days of clear sunny days available in most parts of the Country. Also, it has been noted that, the mean global solar radiation incident over India is of the order of 5.5 to 6.0kwh/sq.mt/day. Accordingly, CERC has considered a CUF of 19% for Solar PV generation. Further, in case of solar thermal generation, CUF of 23% is considered by CERC. GERC has considered 20% for Solar PV generation and 25% for solar thermal generation. As per KREDL, the annual average normal radiation in Gulbarga District is 5.54 kwh/sq.mt/day. KREDL has further stated that, Karnataka State is generally conducive for solar power generation. KPCL has sought 19% CUF as approved in CERC Order. Solitaire Powertech has also sought 19% CUF to be considered.

Considering the fact that, annual average normal radiation falls in the national average values, the Commission proposes to consider CUF of 19% for Solar PV generation and 23% for solar thermal generation.



**f. Operation & Maintenance expenses:**

CERC has considered Rs 9 lakhs per MW as O&M expenses for solar PV and Rs 13 lakhs per MW for solar thermal plants. GERC has considered 0.5% of capital cost i.e, Rs 8.25 Lakhs per MW for solar PV and 1% of capital cost i.e., Rs 13 Lakhs for solar thermal plants. An annual escalation rate of 5.72% has been considered by CERC while GERC has considered the same as 5%. M/s Solitaire Powertech Pvt Ltd has requested to consider O&M expenses of Rs. 9.51 Lakhs per MW with an annual escalation of 5.72%. KPCL has requested to consider O&M expenses of Rs. 9 Lakhs per MW with an annual escalation of 5.72%.

The Commission proposes to consider 9 lakhs per MW for Solar PV plants and 13 lakhs per MW for solar thermal plants with an annual escalation of 5%.

**g. Working capital:**

CERC has considered one month's O&M expenses plus two months receivables plus maintenance spares @ 15% of O&M expenses. GERC has considered one month's receivables and one month O&M expenses for determining working capital requirement for both solar PV and solar thermal plants. M/s Solitaire Powertech Pvt Ltd has considered computation of Working capital based on one month's O&M expenses, 2 months receivables and spares @ 15% of O&M expenses.

The Commission proposes to consider two month's receivables for determining working capital requirement for both solar thermal and solar PV plants.

**h. Interest on working capital:**

CERC has considered interest on working capital at rates equivalent to SBI PLR plus 150 basis points. GERC has considered SBI PLR for interest on working capital. KPCL has requested for interest on Working capital @ 10.25% p.a. M/s

Solitaire Powertech Pvt Ltd has requested for short term SBI PLR in the previous year plus 100 basis points, which works out to 12.89%.

The Commission proposes to consider SBI PLR of 11.75% plus 1.5% i.e., 13.25% for determining interest on working capital for both solar thermal and solar PV plants.

**i. Auxiliary Consumption:**

CERC & GERC have not considered any auxiliary consumption for solar PV plants while 10% of generation is considered as auxiliary consumption for solar thermal plants. The Commission proposes to consider the same.

**III. Impact of Solar Tariff:**

**a. Impact of purchasing solar power on power purchase cost:**

The following table indicates impact on power purchase cost under different scenarios.

Particulars	Addition of Solar energy			
	Scenario-1	Scenario-2	Scenario-3	Scenario-4
	50 MW	100 MW	200 MW	400 MW
Approved Power Purchase quantum for FY10- MU	44375.84	44375.84	44375.84	44375.84
Approved Power Purchase cost for FY10- Rs.Crs	12113.39	12113.39	12113.39	12113.39
Cost of power purchase- Rs/Unit	<b>2.73</b>	<b>2.73</b>	<b>2.73</b>	<b>2.73</b>
Addition of Solar energy in MU @ 19% CUF	83.22	166.44	332.88	665.76
Cost of solar power @ Rs.12 per unit- Rs Crs	99.86	199.73	399.46	798.91
Total energy- MU	44375.84	44375.84	44375.84	44375.84
Cost of power purchase with solar- Rs Crs	12190.54	12267.68	12421.98	12730.57
Cost of power purchase- Rs/Unit	<b>2.75</b>	<b>2.76</b>	<b>2.80</b>	<b>2.87</b>
Increase in cost - Paise per unit	<b>1.74</b>	<b>3.48</b>	<b>6.95</b>	<b>13.91</b>

**\* The above ARR & Power purchase cost are as per Tariff Order 2009.**

It is seen from the above analysis that addition of 50 MW solar energy will result in an increase of 1.74 paise on power purchase cost. Similarly, addition of 400 MW solar energy will result in an increase of 13.91 paise on power purchase cost.

### b. Impact of purchasing solar power on Retail tariff:

The following table indicates impact on Retail tariff under different scenarios.

Particulars	Addition of Solar energy			
	Scenario-1	Scenario-2	Scenario-3	Scenario-4
	50 MW	100 MW	200 MW	400 MW
Approved ARR (with original Power Purchase cost)- Rs Crs	14437.85	14437.85	14437.85	14437.85
Approved Retail sales in MU	34628.17	34628.17	34628.17	34628.17
Average cost of supply- Rs/Unit	<b>4.17</b>	<b>4.17</b>	<b>4.17</b>	<b>4.17</b>
Addition of Solar energy in MU @ 19% CUF	83.22	166.44	332.88	665.76
Cost of solar power @ Rs.12 per unit- Rs Crs	99.86	199.73	399.46	798.91
ARR (with solar power)- Rs Crs	14503.02	14568.18	14698.52	14959.18
Average cost of supply with solar power- Rs/Unit	<b>4.19</b>	<b>4.21</b>	<b>4.24</b>	<b>4.32</b>
Increase in Average cost per unit- Paise/Unit	<b>1.88</b>	<b>3.76</b>	<b>7.53</b>	<b>15.06</b>

**\* The above ARR & Power purchase cost are as per Tariff Order 2009.**

50 MW addition of solar energy will result in an increase of 1.88 paise per unit on average cost of supply. Similarly, 400 MW addition of solar energy will result in an increase of 15.06 paise per unit on average cost of supply.

### IV. Roof top Solar Photovoltaic and other small solar power Plants connected to 11KV and LT Grid of the ESCOMs:

The Jawaharlal Nehru Solar Mission aims at encouraging rooftop and other small solar power plants connected to LT/11KV grid, to replace conventional power and diesel based generators. The mission envisages that the distribution utility will pay the tariff determined by the SERC for the metered energy generated from such applications (whether consumed by the grid connected owner of the rooftop/ground mounted installation or fed into the grid). As per the Solar Mission, a normative generation based incentive will be payable to the utility and would be derived as the difference between the solar tariff determined by CERC for the concerned solar generation technology less an assumed base price of Rs. 5.50/kwh with 3% annual escalation. Funds are proposed to be disbursed through Indian Renewable Energy Development Agency (IREDA), a PSU under MNRE. The

distribution utilities will be entitled to account such electricity generated and consumed within their license areas for fulfillment of Renewable purchase obligation (RPO). The metering and billing arrangements between the utility and rooftop PV operator will be as per guidelines/Regulations of the appropriate Commission.

Accordingly, the Commission proposes to extend the tariff to be determined in this proposed order to all the LT/11kv grid connected Rooftop Solar plants. The Distribution utilities shall be entitled to claim the generation based incentive as detailed above from MNRE.

#### **V. Scope of the proposed tariff determination:**

The Commission proposes to apply this proposed tariff to all the Solar PV and Solar thermal power plants already commissioned by KPCL and proposed plants inclusive of rooftop solar plants whose date of commissioning (CoD) falls on or before **31.03.2014**.

#### **VI. Suggestions/Comments/Views:**

As discussed in the foregoing paras, the Commission proposes to determine tariff on a generic basis for solar power plants (both Solar PV & Solar Thermal). Suggestions/Comments/ Views of the Stakeholders and the general public are invited on the following issues:

1. What should be the tenure of tariff and should the tariff design be based on 10 yrs average or should it be for the useful life of the solar plant ie., 25 yrs?
2. What should be the Capacity utilization factor to be considered for Solar PV and Solar thermal plants?
3. What should be the Capital Cost per MW for Solar PV and Solar thermal plants?

4. What should be the term of Loan and rate of interest, depreciation, working capital and interest on working capital?
5. What should be the rate of return (RoE) on the investments to be considered?
6. Comments/suggestions/views on any other issue which the stake holder feels important for tariff determination.

**The Commission requests all stakeholders and the general public to furnish their views/suggestions/comments before 30.06.2010. The stakeholders are requested to furnish necessary documents in support of their proposals wherever the inputs pertain to financial & technical data so as to enable determination of tariff in a reasonable manner.**

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