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ನಿಯಂತ್ರಣ ಆಯೋಗ



**KARNATAKA ELECTRICITY
REGULATORY COMMISSION**

೬ ಮತ್ತು ೭ನೇ ಮಹಡಿ, ಮಹಾಲಕ್ಷ್ಮಿ ಛೇಂಬರ್ಸ್
ಸಂ.೯/೨, ಎಂ.ಜಿ.ರಸ್ತೆ, ಬೆಂಗಳೂರು ೫೬೦ ೦೦೧

6th & 7th Floor, Mahalaxmi
Chambers, No 9/2, M G Road,
Bangalore 560 001

No.S/03/1/

Date: 21st June 2013

Sir,

Sub: "Discussion paper on Determination of Tariff for grid interactive solar power plants including rooftop and small solar Photo voltaic power plants in Karnataka"

The Commission has issued the "Discussion paper on Determination of Tariff for grid interactive solar power plants including rooftop and small solar Photo voltaic power plants in Karnataka". A copy of the same is enclosed herewith.

You are requested to furnish your views, suggestions, comments if any to the Secretary, KERC, 6th & 7th Floor, Mahalakshmi Chambers, No.9/2, M.G. Road, Bangalore – 560 001, on or before 22nd July 2013.

Thanking you,

Yours faithfully,
For Karnataka Electricity Regulatory Commission

SECRETARY

Encl: As per letter (14 pages)

“Discussion paper on Determination of Tariff for grid interactive solar power plants including rooftop and small solar Photo voltaic power plants in Karnataka”

1. Introduction:

The Commission in its tariff order dated 13th July 2010 had determined tariff for grid connected solar photovoltaic, solar thermal power plants and rooftop solar photovoltaic and other small solar power plants. The tariff determined in this order was valid for projects commissioned upto 31st March 2013.

Now, the Commission, in exercise of powers conferred under Sections 61(h), 62(1) (a) and Section 86(1) (e) of the Electricity Act 2003, and the guidelines under the National Electricity Policy and the Tariff Policy, proposes to determine tariff for grid connected solar photovoltaic plants, solar thermal power plants and small rooftop solar systems for the next control period from 1st April 2013 to 31st March 2015.

2. Solar Power Generation:

The energy demand in the State has been increasing and the thrust on the sector is to create adequate generation capacity to meet this demand. The energy demand from FY12 to FY16 is as follows:

Figures in Million Units				
FY12	FY13	FY14	FY15	FY16
52935	57500	61051	65566	70565

(Data for FY12, FY14-16 is as per Tariff Order 2013 of ESCOMs dated 6th May 2013 and as per provisional data for FY13)

The envisaged growth in FY16 as against FY12 will be 33% i.e an annual average growth of 8%.

The unrestricted energy demand projected for FY17 to FY22 as per the 18th EPS of the Central Electricity Authority are as follows:

Figures in Million Units					
FY17	FY18	FY19	FY20	FY21	FY22
78637	83917	89285	95059	101309	108012

The growth of unrestricted demand will be 37% from the base figures of FY17 indicating an annual average increase of about 8%.

The increasing demand against insufficient power generation has resulted in shortages both in terms of energy and peak power. While the State has taken some initiatives to build conventional large thermal power plants adding to the existing plants at Raichur and Bellary, the cause of concern is insufficient availability of indigenous coal and the high cost of importing coal besides the impact on the environment. Thus, there is a need to find alternate sources of energy that would meet energy demand besides being environmentally benign and sustainable. One such source is Solar Power generation.

The State receives solar radiation in the range of 5.1 to 6.4 kWh/sq.m in summer months, 3.5 to 5.3 kWh/sq.m during monsoon and 3.8 to 5.9 kWh/sq.m in winter. KREDL has projected a Solar grid connected power potential of 5000 MW for the State. The installed capacity for generation by grid connected solar power as at the end of March 2013 was only 14 MW in the State. This amounted to about 1% of total solar installed capacity in the country which was of the order of 1440 MW as at the end of March 2013. Some of the States which have significant solar power generation capacity include Gujarat (824 MW), Rajasthan (442 MW), Maharashtra (34 MW), Andhra Pradesh (23 MW) and Tamil Nadu (17 MW).

Karnataka is one of the pioneer States in the Country to build megawatt scale solar power plants. At present, the State has 14 MWp of Solar Photovoltaic power generation already commissioned and connected to the State grid. Further, about 80 MWp has been awarded to various developers on competitive bidding route and another 130 MWp is in the process of finalisation by the State nodal agency, KREDL. Another 48 applications totalling to about 1501 MW is pending finalisation with KREDL.

Pursuant to the provisions under Section 86(1)(e) of the Electricity Act, 2003 and clause 6.4 of Tariff Policy, the Commission has notified Regulations on fixing Renewable purchase obligations (RPO). As per the KERC (Power Procurement from Renewable Sources by Distribution Licensee and Renewable Energy Certificate Framework) Regulations, 2011 notified on 16th March 2011, every distribution licensee in the State has to procure 0.25% of their total procurement from solar power. The Regulations provide for purchase of solar energy or solar renewable energy certificates (REC) to meet the solar renewable power procurement obligations.

The Ministry of New and Renewable Energy (MNRE) vide its letter dated 14th January 2013 has stated that, capital subsidy to the tune of 30% of the cost of the project is provided for promoting grid connected rooftop / ground mounted solar PV power plants. Considering this subsidy, the MNRE has stated that the cost of green power generation would be Rs.6-7 per Kwh in the long term. The MNRE has requested the SERCs to determine tariff for roof top systems considering 30% capital subsidy and or accelerated depreciation.

3. Determination of tariff:

In the above context, determination of preferential tariff for grid connected solar power is considered crucial for promoting the development of solar power as an important source of green power in the State. The Commission notes that CERC and other SERCs which have recently determined tariff for solar power have, considered the following parameters.

i. Applicable for Solar photovoltaic plants:

Parameter	CERC Order dated 27 th March 2012 applicable for projects commissioned during FY13	GERC order dated 27 th January 2012 for projects commissioned during FY13	RERC order dated 30 th May 2012 for projects commissioned upto 31.03.2014	KERC order dated 13 th July 2010 for projects commissioned upto 31 st March 2013
Useful life	25 Years	25 Years	25 Years	25 Years
Capacity Utilisation factor	19%	18%	20% with a deration of 0.5% p.a.after second year	19%
Capital Cost in Rs.Crs./ MW	10.00	10.00	9.40	15.50
Debt Equity Ratio	70 : 30	70 : 30	70 : 30	70 : 30

Cost of Debt	12.30%	13%	12.30%	12%
Period of Debt	12 Years	10 Years	12 Years	10 Years
Cost of Equity	20% for first 10 years and 24% from 11 th year onwards (weighted average rate is 22.40%)	14%	16%	16%
Discount Rate	10.62%	10.74%	13.41% (equivalent to WACC)	13.20%
Depreciation	5.83% for first 12 years and 1.54% from 13 th year onwards	6% for first ten years and 2% for next fifteen years	5.28% upto 12 years and 2.05% for balance period	7% for first ten years and 1.33% for next fifteen years
Working Capital	1 month O & M plus 15% of O & M expenses towards maintenance spares plus two months' receivables	1 month O & M plus one months' receivables at normative CUF	1 month O & M plus 15% of O & M expenses towards maintenance spares plus 1.5 months' receivables	2 months' receivables
Interest on Working Capital	12.80%	12.00%	11.80	12.50%
O & M Expenses	Rs.11 lakhs per MW with an escalation of 5.72% per annum	0.75% of the capital cost with an escalation of 5.72% per annum	Rs.11 lakhs per MW with an escalation of 5.72% per annum	Rs.9.00 lakhs per MW with escalation of 5% per annum
Tariff	Rs.10.39 (without accelerated depreciation) Rs.9.35 (with accelerated depreciation)	i) With accelerated depreciation Rs.8.63 for 25 years or Rs.9.13 for first 12 years and Rs.7.00 for next 13 years Rs.10.36 for kilowatt scale PV plants ii) With out accelerated depreciation Rs.9.64 for 25 years or Rs.10.30 for first 12 years and Rs.7.50 for next 13 years Rs.11.57 for kilowatt scale PV plants	Rs.9.63 (without accelerated depreciation) Rs.8.42 (with accelerated depreciation) (this is also applicable for rooftop solar PV plants)	Rs.14.50 per unit for solar PV plants and rooftop systems commissioned before 31 st March 2013.

ii. Applicable for Solar Thermal plants:

Parameter	CERC Order dated 27 th March 2012 applicable for projects commissioned during FY13	GERC order dated 27 th January 2012 for projects commissioned during FY13	RERC order dated 30 th May 2012 for projects commissioned upto 31.03.2015	KERC order dated 13 th July 2010 for projects commissioned upto 31 st March 2013
Useful life	25 Years	25 Years	25 Years	25 Years
Capacity Utilisation factor	23%	23%	23% with deration factor of 0.25%p.a after 4 th year	23%
Capital Cost in Rs.Crs./ MW	13.00	14.00	12.75	13.00
Debt Equity Ratio	70 : 30	70 : 30	70 : 30	70 : 30
Cost of Debt	12.30%	13%	12.30%	12%
Period of Debt	12 Years	10 Years	12 Years	10 Years
Cost of Equity	20% for first 10 years and 24% from 11 th year onwards (weighted average rate is 22.40%)	14%	16%	16%
Discount Rate	10.62%	10.74%	13.41% (WACC)	13.20%
Depreciation	5.83% for first 12 years and 1.54% from 13 th year onwards	6% for first ten years and 2% for next fifteen years	5.28% upto 12 years and 2.05% for balance period	7% for first ten years and 1.33% for next fifteen years
Working Capital	1 month O & M plus 15% of O & M expenses towards maintenance spares plus two months' receivables	1 month O & M plus one months' receivables at normative CUF	1 month O & M plus 15% of O & M expenses towards maintenance spares plus 1.5 months' receivables	2 months' receivables
Interest on Working Capital	12.80%	12.00%	11.80%	12.50%
O & M Expenses	Rs.15 lakhs per MW with an escalation of 5.72% per annum	1.50% of the capital cost with an escalation of 5.72% per annum	Rs.15 lakhs per MW with an escalation of 5.72% per annum	Rs.13.00 lakhs per MW with escalation of 5% per annum
Tariff	Rs.12.46 (without accelerated depreciation) Rs.11.22 (with accelerated depreciation)	Rs.12.91 (without accelerated depreciation) Rs.11.55 (with accelerated depreciation) (this is also	Rs.11.95 (without accelerated depreciation) Rs.10.45 (with accelerated depreciation) (this is also applicable for rooftop solar PV plants)	Rs.11.35 per unit for plants commissioned before 31 st March 2013.

3.1. Determination of Tariff for Megawatt scale Solar PV and Solar Thermal power plants

The following parameters are proposed to be considered for the determination of tariff of Megawatt scale Solar PV and Solar Thermal power plants:

i) Life of the Plant:

Manufacturers of Photovoltaic modules provide a warranty of 25 years. Since these modules form the core component of the solar power generation, the life of the plant could be linked to the life of the modules. Further, the point of contention is that so far there is no established life of solar plants in India and as such solar power generation is in its nascent stage.

Hence for the present, the Commission proposes to consider the life of plant at 25 years for the purpose of determination of tariff.

ii) Term and Tariff design:

Since the life of the plant is being considered at 25 years, the Commission proposes to adopt levelised tariff for a period of 25 years. The levelised tariff is considered to provide constant revenue flows duly taking into consideration the time value of money. The Commission desires to know whether separate tariff should be determined for power plants availing the benefits of capital subsidy from MNRE, accelerated depreciation etc.

iii) Capacity Utilisation factor:

The Commission in its tariff order dated 13th July 2010 had considered CUF of 19% for solar photovoltaic plants and 23% for solar thermal plants. The CUF considered by other Commissions is as follows:

Particulars	CERC	GERC	RERC
Solar Photovoltaic	19%	18%	20% with deration of 0.5% p.a after second year
Solar Thermal	23%	23%	23% with deration of 0.25% p.a after the fourth year

The Commission proposes to consider CUF of 19% for solar photovoltaic plants and 23% for solar thermal plants.

iv) Capital Cost:

The Commission in its tariff order dated 13th July 2010 had considered capital cost of Rs.15.50 Crores per MW for solar PV and Rs.13.00 Crores per MW for solar thermal plants.

The capital costs considered by other Commissions are as follows:

Particulars	CERC	GERC	RERC
Solar PV	10.00 Crores / MW	10.00 Crores / MW	9.40 Crores / MW
Solar Thermal	13.00 Crores / MW	14.00 Crores / MW	12.75 Crores / MW

It is gathered that the present capital costs are ranging from Rs.9.40 Crores to Rs.10.00 Crores for solar PV, Rs.12.75 Crores to Rs.14.00 Crores for solar thermal plants.

Further, the Commission proposes to consider a debt equity ratio of 70:30 for the purpose of factoring loan and equity.

The capital cost consists of the cost of equipments along with cost of land. Considering the trends available, the Commission needs to take a view on the prevailing and projected capital cost.

v) Operation & Maintenance Cost:

The operation and maintenance cost consists of employee cost, administrative and general expenses and Repairs & Maintenance expenses. The Commission in its earlier order had considered O & M expenses of Rs.9.00 lakhs / MW for solar PV plants and Rs.13.00 lakhs / MW for solar thermal plants with an annual escalation of 5%.

CERC has considered O & M expenses of Rs.11.00 lakhs / MW for solar PV plants and Rs.15.00 lakhs / MW for solar thermal plants with an annual escalation of 5.72%.

GERC has considered O & M expenses of 0.75% of capital cost i.e. Rs.7.50 lakhs / MW for solar PV plants and 1.50% of the capital cost i.e. Rs.21.00 lakhs / MW for solar thermal plants with an annual escalation of 5.72%.

The Commission is of the view that it would be appropriate to consider a percentage of the capital cost as O & M expenses duly providing annual escalation to meet the inflationary costs.

vi) Auxiliary consumption:

The Commission in its earlier order had considered auxiliary consumption of 8% of the gross generation by solar thermal plants. While CERC has considered auxiliary consumption of 10% for solar thermal and no auxiliary consumption for solar photovoltaic, GERC has considered 10% for solar thermal and 0.25% for solar photovoltaic plants.

The Commission needs to arrive at an appropriate percentage of auxiliary consumption to be considered for determination of tariff.

vii) Interest and Tenure of Debt:

Considering the normative tenure of long term debts, the Commission proposes to consider the tenure of debts as 10 years. Interest on debt, mainly depends on the risk factors involved in financing the projects. The Commission needs to consider appropriate interest on debt.

viii) Working Capital:

The Commission in its earlier tariff order had considered two months receivables as working capital. CERC and RERC have considered one month O & M expenses plus 15% of O & M expenses towards maintenance spares plus 1 ½ of months receivables as allowable working capital. GERC has considered one month O & M expenses plus one month's receivables at normative CUF. The Commission needs to consider the appropriate working capital.

ix) Interest on Working Capital:

As regards interest on working capital, the Commission in its earlier Order had considered interest on working capital @ 12.50%. The interest on working capital considered the other Commission's ranges from 11.80% to 12.80%. Considering the prevailing base rates and interest rates on short term loans, the Commission has to decide on the allowable interest on working capital.

x) Depreciation:

Since the Commission has proposed 70% of the capital cost to be financed by debt component and the tenure of debt being 10 years, the Commission needs to provide adequate depreciation to meet the loan repayment.

xi) Return on Equity:

The Commission in its earlier tariff order has allowed RoE of 16% and the actual tax component as a pass through. The Commission is of the view that 16% return on equity with actual tax as pass through would induce investment in solar power projects.

xii) Discount Rate:

This factor is required to compute the time value of money. Since the financing of capital cost is based on 70% debt and 30% equity, the Commission is of the opinion that it would be appropriate to consider weighted average cost of capital (WACC) as the discount factor.

3.2. Grid connected Rooftop Solar PV and other small Solar Power Plants:

The grid connected rooftop and small solar photovoltaic plants are perceived to have a large potential for generating solar power using unutilised space on rooftops and vacant lands around buildings. Such systems would be a possibility if necessary arrangements for connectivity and metering are made available besides determination of appropriate feed in tariff. The Commission in its previous tariff order dated 13th July 2010 had extended the tariff determined for megawatt scale Solar PV plants to the rooftop solar PV plants also.

A solar rooftop plant of kilowatt scale is an investment mainly made by domestic and commercial consumers. This power could be used to meet their self-consumption besides availing the option of selling any excess generation to the utility.

The various options for such small capacity investors would be:

- i. Sell the entire energy generated to the distribution licensee at the tariff determined by the Commission.
- ii. Utilise for own needs and sell surplus to the licensee.
- iii. Set up an off grid system and claim tariff determined by the Commission for small solar systems for avoided utilisation of grid power.

In this discussion paper, in the foregoing sections, the Commission proposes to determine tariff for such rooftop solar plants, besides grid connected megawatt scale solar power plants.

3.3 Grid Connectivity Standards:

For any generation whether large scale or small rooftop systems, the basic requirements would be:

- Providing grid connectivity
- Ensuring safety of system
- Enabling metering

The grid connectivity standards for distributed generation are being finalised by the Central Electricity Authority.

In case the investors opt for selling surplus beyond their own consumption, then the concept of adopting net metering would be useful. Net metering would provide data on energy consumed by the Consumer from distribution licensee's source as well as energy injected by the solar plant to the distribution licensee's grid.

3.4. Manufacturers/Energy Service Cos (ESCOs) Perspective on harnessing solar power:'

In view of the large potential of rooftop solar photovoltaic power generation, the Commission held a meeting with manufacturers of solar power systems /Energy Service Cos (ESCOs).The issues pertaining to providing grid connectivity, ensuring safety of system/equipment, introduction of net metering, options of grid connected / off grid systems, available subsidies / incentives and assessment of capital cost were discussed.

Generally the representatives were of the view that providing net metering facility along with reasonable tariff would induce investors to invest on rooftop solar systems. Some of the participants suggested that financial incentives (similar to those offered for solar water heaters) along with adoption of energy efficient appliances can attract investments. It was also opined that off grid solar systems could also be encouraged with reasonable tariff for self consumption of solar energy.

3.5. Determination of Tariff for Other small kilowatt scale rooftop / ground mounted solar power plants connected to Distribution network at LT / 11 KV:

The following parameters are proposed to be considered for the determination of tariff of kilowatt scale small solar rooftop / ground mounted power plants connected to Distribution network at LT / 11 KV:

i. Capacity Utilisation factor:

The CUF is dependent on the solar irradiation, ambient temperature, type and quality of the module besides the efficiency of the allied equipments. CEA in one of its report on 'Performance of solar plants in India' has assessed the capacity utilisation factor in Bangalore at 19.82%. Considering the overall solar irradiation being received in the State, it is proposed to consider CUF at 19%.

ii. Capital Cost:

The cost of small grid connected solar PV units of 100KWp size is estimated at Rs.0.8 to 0.9 Crore. This indicates that the cost per KW would be Rs. 0.80 lakhs to Rs 0.90 lakhs. GERC has considered capital cost of Rs. 1.20 lakhs per KW.

iii. O&M Expenses:

Generally it is observed that the small rooftop PV systems do not require any maintenance except cleaning of solar panel surface on a routine basis to keep them efficient besides checking electrical connections and attending to any trouble shooting. As such a nominal allowance for O&M expenses needs to be considered.

iv. Depreciation:

It is proposed to allow depreciation equivalent to recover loan repayment within a period of ten years. 70% of the investment being loan component, the depreciation on straight line method will be 7% per year and thereafter 1.33% for balance 15 years.

v. Interest and Finance charges:

Investments made on normative debt equity of 70:30 is to be factored for allowing interest cost at the prevailing market rates so as to enable investors to recover their costs.

vi. Return on Equity:

As considered for megawatt scale plants, the Commission is of the view that 16% RoE could be factored for determining the tariff.

The tariff proposed to be determined will be applicable to the solar plants commissioned on or before 31st March 2015.

4. Suggestions/Comments/Views:

As discussed in the foregoing paras, the Commission proposes to determine tariff on a generic basis for solar power plants including rooftop solar systems. Suggestions/Comments/ Views of the Stakeholders and the general public are invited on the following issues pertaining to megawatt scale solar plants and small kilowatt scale solar plants:

1. Tenure of tariff and tariff design (whether levelised tariff / average tariff two part or single part tariff) of the solar plant
2. Capacity utilization factor to be considered for Solar PV, solar rooftop and Solar thermal plants
3. Capital Cost per MW for Solar PV and Solar thermal plants and capital cost per KW for small kilowatt scale plants
4. Whether separate tariff is required to be determined for projects availing capital subsidy, accelerated depreciation etc.
5. What should be the annual O&M expenses?
6. In respect of kilowatt scale plants,
 - a. Which of the following options be allowed:
 - i. Sell the entire energy generated to the distribution licensee at the tariff determined by the Commission.
 - ii. Utilise for own needs and sell surplus to the licensee.

- iii. Set up an off grid system and claim tariff determined by the Commission for small solar systems for avoided utilisation of grid power.

 - b. What capacity of small rooftop solar systems should be allowed to be connected to the distribution licensee's grid?
 - c. What should be the metering arrangement (should it be based on separate meters for injection of solar power and self consumption from distribution licensee's source or should it be with facility of metering import and export in a single energy meter).
7. Comments/suggestions/views on any other issue which the stake holder opines as important for tariff determination.

The Commission requests all stakeholders and the general public to furnish their views/suggestions/comments before 22nd July 2013. The stakeholders are requested to furnish any documents or material as may be available in support of their proposals / views so as to enable determination of tariff in a reasonable manner.