

**KARNATAKA ELECTRICITY REGULATORY COMMISSION**

No.9/2, 6<sup>th</sup> & 7<sup>th</sup> Floor, Mahalaxmi Chambers,  
M.G. Road, Bangalore-560 001

<b>Present:</b>	Shri. M.K. Shankaralinge Gowda	Chairman
	Shri. H.D. Arun Kumar	Member
	Shri. D.B. Manival Raju	Member

In the matter of:

**Determination of tariff for Grid Interactive Megawatt scale Solar Power Plants**

**ORDER**

S/03/1

Date: **30<sup>th</sup> July, 2015**

**1. Preamble:**

The Commission in its Tariff Order dated 10<sup>th</sup> October, 2013 had determined the 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 applicable for the projects entering into power purchase agreement on or after 1<sup>st</sup> April, 2013 and upto 31<sup>st</sup> March, 2018 but excluding those projects in respect of which the tariff is discovered through competitive bidding process.

The Bangalore Electricity Supply Company (BESCOM) in its Review Petition RP No. 7/2014 filed on 12<sup>th</sup> August, 2014 had sought review of the Commission's Order dated 10<sup>th</sup> October, 2013 and sought the following reliefs namely:

- (i) Determination of capital cost for Solar PV plants at Rs.691 Lakhs as against Rs.830 lakhs;
- (ii) Determination of O&M cost of solar thermal projects as per CERC Order dated 15<sup>th</sup> May, 2014 at Rs.15 lakhs per annum with an annual escalation of 5.72%; and
- (iii) Consequential reduction in Tariff determined

The Commission, in its Order dated 1<sup>st</sup> January, 2015 on BESCO's Review Petition RP No.7/2014, while dismissing the Review Petition as not maintainable noted that there has been substantial reduction in capital cost after issue of its Order dated 10<sup>th</sup> October, 2013 and therefore decided to examine the need to curtail the present control period and re-determine the tariff in separate proceedings, in due course.

Pursuant to such decision, the Commission had issued a discussion paper in the matter, on 5<sup>th</sup> May, 2015 inviting comments / suggestions from the stakeholders, to be submitted to the Commission on or before 5<sup>th</sup> June, 2015. In response to the said discussion paper, various Stakeholders, including KREDL and some of the ESCOMs submitted their written comments / suggestions. The Commission also held a public hearing in the matter on 2<sup>nd</sup> July, 2015 in the court hall of the Commission, wherein stakeholders made their oral submissions before the Commission.

The List of the stakeholders who have filed their comments/suggestions and those who have made oral submissions in the public hearing is given in the Annexure to this Order.

Now, in exercise of powers conferred under Section 62(1)(a) read with Section 64 and Section 86(1)(e) and other enabling provisions of the Electricity Act 2003, the Commission hereby passes the following Order:

**2. Need for midcourse revision of tariff:**

The Commission in its Order dated 10<sup>th</sup> October, 2013 had specified that the tariff determined in the Order is applicable to all solar power generators entering into Power Purchase Agreements (PPAs) on or after 1<sup>st</sup> April, 2013 and upto 31<sup>st</sup> March, 2018 excluding those projects in which the tariff is discovered through bidding process. While such a five year control period envisaged ensuring prospective investors with assured returns and sufficient time to plan, design and commission the projects more efficiently and effectively, it would also have facilitated the concerned ESCOMs to account for procurement of solar energy at such tariff in their ARR.

The Commission however, considers that if there are substantive midcourse improvement in technology, reduction in manufacturing cost of solar panels and allied equipments, and reduction of cost in solar power generation, non-consideration of such factors would militate against the interest of consumers and also discourage innovation in technology, mass production and adoption of more cost effective implementation of solar projects. The Commission is empowered and expected to take corrective measures to rectify any anomalous situation arising out of such developments during a specified control period when tariff has been determined based on prevailing cost of equipments and other parameters / norms. Under Clause 9 of the KERC (Procurement of Energy from Renewable Sources) Regulations, 2011, this Commission has been conferred with the power to modify the tariff anytime either suo-moto or on application filed by any generator or distribution licensee. The Commission is of the considered view that there is sufficient justification to modify the tariff fixed in 2013 Order. Further, it needs to be ensured that those diligent investors who take expeditious steps to commission their projects benefit from a fixed generic tariff regime during any control period rather than those who merely express their intention to do so.

Hence, it is deemed fit to curtail the control period of the generic tariff determined for solar projects in the Order dated 10<sup>th</sup> October, 2013 and re-

determine the tariff prospectively. At the same time, it needs to be ensured that, such an exercise does not cause hardship to those who have already committed to invest in solar projects based on the tariff determined in the Order dated 10<sup>th</sup> October, 2013 with their projects being in advanced stage of implementation and who are not in a position to take advantage of the subsequent cost reduction and technological advancement in power generation through solar plants.

### **3. Applicability of the Order:**

In view of the above, the Commission, in modification of its Order dated 10<sup>th</sup> October, 2013, decides that the norms and tariff determined in this Order shall be applicable to all new grid connected MW scale solar PV and solar thermal power plants, entering into Power Purchase Agreement (PPA) on or after 1<sup>st</sup> September, 2015 and getting commissioned during the period from 1<sup>st</sup> September, 2015 to 31<sup>st</sup> March, 2018 for which PPAs have not been entered into, prior to 1<sup>st</sup> September, 2015.

In respect of the projects that are commissioned during the period from 1<sup>st</sup> September, 2015 to 31<sup>st</sup> March, 2018 for which PPAs have been entered into and submitted to the Commission prior to 1<sup>st</sup> September, 2015 for approval, the tariff as per the said agreement shall be applicable.

The tariff determined in this Order shall be applicable for the term of the PPAs entered into in respect of projects covered by this Order.

However, the tariff in respect of rooftop and small solar PV plants would continue as per the Commission's Order dated 10<sup>th</sup> October, 2013.

### **4. Determination of Tariff for Megawatt scale Solar PV and Solar Thermal power plants**

The Comments / suggestion of the stakeholders and the decisions of the Commission on the capital cost, operational and financial parameters for

determination of tariff, for grid connected MW scale solar PV and solar thermal power plants are discussed below:

**i) Life of the Plant:**

The Commission, in its discussion paper, had proposed to consider 25 years as the life of the plant, for the purpose of determination of tariff.

Sri. M.R.C. Chouhan and others have submitted that, the life of plant at 25 years as decided in the Order dated 10<sup>th</sup> October, 2013 should be continued.

**Commission's Decision:**

Considering the life assured by the manufacturers/developers and the life considered by other Commissions in the country for similar plants, **the Commission decides to retain the life of plant as 25 years, for the purpose of determination of tariff.**

**ii) Term and Tariff design:**

The Commission had proposed to continue with the levelized tariff for a period of 25 years, in order to ensure certainty of revenue streams to investors.

Sri. Ramesh Babu, Spokesperson, Janata Dal (S), submitted that 25 years term of PPA is too long and suggested that, as existing in other States it should be fixed for 10 - 15 years.

Sri. M.R.C. Chouhan and others have submitted that, the Commission has decided to provide levelized tariff at a rate of Rs.8.40/unit which should not be reduced, as this discourages the entrepreneurs.

Dr. Chakravorthy, National Institute for Advance Studies submitted that the tariff parameters indicated in the discussion paper are valid and suggested

that the solar tariff should be determined annually as solar technology is rapidly developing and costs are coming down.

**Commission's Decision:**

The Commission notes that, owing to improvement in technology and change in market conditions, the prices of the modules of the solar PV plants have significantly reduced over the years and such reduction in cost should be shared equitably with the consumers. Hence, the process of determination of tariff has been taken up by the Commission by cutting short the control period.

Some of the stakeholders have suggested reducing the period of tariff to 10 to 15 years instead of 25 years, which they consider as too long and would result in burden on consumers.

As discussed in the following paragraphs of this Order, the investments made in solar projects are proposed to be allowed to be recovered through tariff over a period of time. The debt recovery period is considered at 12 years. If the tariff period is reduced to 10 to 15 years, with the life of the plant being 25 years, the benefits of the investments made would not be completely absorbed. Further, reasonable returns for any investment needs to be allowed during the life of the plant.

**Hence, the Commission decides to retain the levelised tariff for a period of 25 years.**

**iii) Capacity Utilisation factor:**

The Commission had proposed capacity utilisation factor of 19% for solar PV plants and 23% for solar thermal plants.

Sri M.R.C.Chouhan and others have submitted that, CUF varies according to structure and nature of the plants erected. Hence, the same should not be re-determined.

Sri Ulhas Sidramappa Arakeri has stated that the generation should be limited to 1.664 MU/MW/annum. Sri Yathiraju has suggested that in certain areas of the State CUF of more than 19% can be achieved.

Sunil Roopsingh Rathod, Vijayapura, has submitted that the normative generation of 1.66MU at 19% PLF should be purchased by the ESCOMs at the Commission specified tariff and any generation over the normative generation can be purchased by the ESCOMs at a discounted rate mutually agreed upon.

Shri A.R. Sonnad, Bijapur has requested the Commission not to revise the maximum CUF from 1.838 MU/MW/annum to 1.664 MU/MW/annum. He submitted that CUF of more than 19% can be achieved by using best quality panel, invertors and other accessories, since as per records the average global horizontal irradiance (GHI) is 5.88 kWh/m<sup>2</sup> and annual average direct normal irradiance (DNI) is 5.39 kWh/m<sup>2</sup> in Bijapur.

BESCOM has cited three power plants namely M/s Azure Power, M/s Bhoruka Power and M/s Jindal Aluminium, wherein CUF of 19.76% to 25.38% has been recorded during the period January 2015 – April 2015. Hence, BESCOM has suggested considering a CUF of 22%.

**Commission's Decision:**

The Commission notes that the CUF of 22% suggested by BESCOM pertains to the CUF recorded in the solar PV plants during January – April period which are summer months in the State where solar insolation is on a higher side. The CUF has to be fixed based on the annual data of a power plant and not based on the performance only during a part of the year.

As per the data published on the website of MNRE, the capacity utilization factor for solar PV plants considered by CERC and most of the SERCs in the country is 19%. Since the Commission is determining the tariff on generic basis

and not on location basis, the Commission decides to adopt a single CUF for the entire State. Further, CERC has adopted 23% CUF for solar Thermal.

**In the circumstances, the Commission decides to retain the CUF at 19% for Solar PV and 23% for solar thermal plants.**

**iv) Degradation Factor:**

M/s Sun Edison have suggested to consider annual degradation for solar PV by accounting reduced PLF every year at a rate of 1% annual degradation for the first 10 years and 0.66% per annum degradation for the next 15 years.

M/s Hindustan Power, Delhi has submitted that there is natural degradation and due to that, the manufacturers generally guarantee a performance of more than 90% for the first ten years and a performance of more than 80% for the next 15 years, which implies an annual degradation rate of about 0.9% for the PV modules.

**Commission's Decision:**

The Commission notes that there is no reliable data on degradation, as solar power generation in the Country is in the nascent stage. The Commission has not factored additional capital cost towards degradation as considered by the CERC. However, considering the quantum of such provision made in other SERCs, for the present, **the Commission decides to allow reduction of 0.5% of net generation as annual degradation from the fifth year onwards.**

**v) Capital Cost:**

The following are the capital cost norms proposed in the discussion paper:



**Break-up for capital cost considered by KERC**

Sl. No.	Particulars	Capital cost Norm for Solar PV project (Rs. Lakh/MW)
1	PV Modules (@ Rs. 62.393/ US \$)	311.965
2	Land Cost	25
3	Civil and General Works	50
4	Mounting Structures	50
5	Power Conditioning Unit	45
6	Cables and Transformers	50
7	Preliminary and Pre-operative expenses IDC etc.	40
<b>8</b>	<b>Total Capital Cost</b>	<b>571.965</b>

Accordingly, the Commission proposed to consider capital cost of Rs.572 Lakhs per MW for Solar PV plants.

CESC has submitted that the capital cost considered is less than the benchmark cost of Rs.605.85 lakhs/MW fixed by CERC for FY16, which is reasonable.

Sri M.R.C. Chouhan and others have submitted that, the cost of equipments, infrastructure etc., varies from manufacturer to manufacturer i.e. if the licensee uses Tier-1 products with higher life and generation guarantee, the cost would come upto 9 to 10 Crores / MW. If Tier-2 products with comparatively lesser efficiency are installed, the cost would be around Rs.7 to 8 Crores and if Tier-3 products with no generation guarantee and with lesser/least efficiency, the cost would be around Rs.6 to 7 Crores. Hence, to maintain the standard of the project and assured generation for 25 years, the investors are forced to look for Tier-1 product or alternatively Tier-2 products, with an average cost of Rs.8 to 9 Crores/MW.

M/s JUWI have submitted to consider exchange rate of Rs.63.50 / US \$ and have stated that the module price which is currently at 0.52 US\$ / Wp, is not predicted to drop further in the near future.

Ms. Archana Bhat, AWI Solar Energy, submitted that the cost of MW scale solar plants is high and is at more than Rs.6.00 Crores per MW. She submitted that the manufacturers of inverters and transformers do not guarantee their equipments beyond one or two years and the rupee dollar exchange rate is

dynamic, leading to higher capital costs. She also suggested that considering higher radiation in certain areas would enable higher energy generation, energy generation of more than 1.664 MU/MW/annum may be reckoned.

Sri Dinesh Kagathi, PRDCL submitted that generation of 1MW AC power is possible only if the DC capacity is 1.1MW, which increases the module cost by Rs.20 lakhs and that the proposed capital cost would be applicable to large scale plants and the capital cost of smaller projects will be higher by 10%. Hence the capital cost of Rs.6.03 Crores per MW needs to be considered.

Sri Rajashekar S Nadagouda, Vijayapura, has submitted that the capital cost of Rs.8 Crore / MW as per the existing Order may be retained. He has stated that, procurement of Tier – 1 good quality materials is not possible at a cost of Rs.5.87 Crores / MW as suggested in the discussion paper. He has stated that the cost of the land, transportation cost, installation charges, insurance and exchange rates are comparatively increasing.

Sri Ulhas Sidramappa Arakeri and Sri Sunil Roopsingh Rathod, Vijayapura, have submitted that the capital cost suggested at Rs.5.71 Crores / MW may hold good for projects of more than 10 MWp and will not be possible for project size of 1 to 3 MW which would cost from Rs.6.75 to Rs.7.60 Crores / MW. Also the cost of evacuation would vary depending upon the type of land and the distance from the sub-station. Further, equity to an extent of 20% has to be arranged from private lenders and financing of balance 80% without any collateral security, may not be possible.

M/s AVI Solar Energy Pvt. Ltd., Bangalore, have submitted that the capital cost for 1 to 3.3 MWp should be Rs.635 lakhs / MWp plus transmission line cost of Rs.40 lakhs and for plant size of 4 MWp to 11 MWp it should be Rs.615 lakhs / MW plus transmission line cost of Rs.90 lakhs.

M/s PRDCL have submitted that, the proposed CUF of 19% is possible only if the installed capacity of the panels is 1.1 times the nominal capacity of the plant. Hence, the project cost should be 10% more than the suggested cost.

Accordingly, the project cost of Rs.603 lakhs/MW would be appropriate for power plants of more than 10 MW capacity. They have also suggested that the project cost for 1 to 3 MW will be higher on account of lower volume of generation and higher cost of evacuation and hence a capital cost of Rs.663 lakhs/MW may be considered.

M/s SAILIS Projects Pvt. Ltd., Hyderabad, have indicated the breakup of capital cost as follows:

- i) PV modules - Rs.352.99 lakhs /MW.
- ii) Shift liner charges, logistics - Rs.9.00 lakhs/MW.
- iii) Power Evacuation cost - Rs.20.00 Lakhs/MW.
- iv) Applicable taxes - Rs.15.00 lakhs/MW.
- v) Additional 10% for generation of AC power - Rs.69.50 lakhs/MW.

Thus the capital cost should be in the range of Rs.750 – Rs.800 lakhs / MW.

Sri G.G. Hegde Kadekodi, Sirsi, has agreed with the capital cost suggested by the Commission.

M/s Hindustan Power, Delhi, have suggested the following breakup of capital cost:

Sl.No.	Project cost Head	Proposed cost in Rs. Lakhs/MW
1	PV Modules	384
2	Land Cost	120
3	Civil and General works	50
4	Mounting structures	50
5	Power Conditioning Unit	65
6	Evacuation cost up to Inter-connection Point (Cables & Transformers)	60
7	Preliminary and Pre-operative expenses including IDC and contingency	81
	<b>Total Project cost</b>	<b>810</b>

They have requested to allow capital cost of Rs.8.10 Crores / MW.

Prof. D P Sengupta, has agreed with CERC norms and has suggested that the capital cost may be determined annually as there is rapid evolution of technologies and rapid decline in costs.

M/s Sun Edison has suggested to consider average module price of \$ 0.584 per Wp. They have further submitted that the cost of the Indian modules and cells are 17% higher than Chinese modules and hence the cost would be \$ 0.69 per Wp. Further, they have requested to consider 10% to 20% additional capacity for arriving at the module cost. Further, they have suggested considering exchange rate of Rs.64.85 per US \$. The cost of transmission lines from pooling station to nearest grid sub-station is in the range of Rs.30 lakhs / MW to Rs.50 lakh / MW depending upon the length of the transmission lines. Hence the cost of the cables and transformers should be Rs.80 lakhs / MW. They have suggested considering capital cost of atleast Rs.6.40 Crores per MW.

BESCOM has requested to consider capital cost of Rs.5.65 Crores / MW for solar PV and Rs.11.82 Crores / MW for solar thermal power plants as considered by Rajasthan Electricity Regulatory Commission.

**Commission's Decision:**

The Commission in its Tariff Order dated 10<sup>th</sup> October, 2013 had considered capital cost of Rs.8.30 Crores per MW for solar PV and Rs.12.00 Crores per MW for solar thermal plants.

The capital costs considered by other Commissions are as follows:

Particulars	CERC	HERC	RERC
Solar PV	Rs.6.06 Crores/MW	Rs.6.81-7.05 Crores / MW	Rs.5.96 Crores / MW
Solar Thermal	Rs.12.00 Crores / MW	Rs.12.00 Crores / MW	Rs.11.82 Crores / MW

It is observed that the CERC in its Order dated 31<sup>st</sup> March, 2015, in the matter of determination of benchmark capital cost norm for Solar PV power projects and Solar Thermal power projects, has carried out a detailed analysis for evolving the benchmark capital cost norm for Solar PV Power Projects applicable during FY 2015-16.

The CERC in the above Order, has considered the average module cost of 0.52 US\$/Wp for determination of benchmark capital cost for FY 2015-16 and considering an average of exchange rate of Rs.62.05/US\$ of past six months, CERC has arrived at module cost of Rs.322.66 Lakh/MW for FY16. Further, the CERC in the above mentioned Order has considered an amount of Rs.9.69 lakhs / MW towards compensation of module degradation. Accordingly, CERC has determined the benchmark capital cost for Solar PV power projects as Rs.6.06 Cr/MW and Rs.12.00 Crores / MW for solar thermal power projects for determination of tariff for FY16. The breakup of capital cost is as under:

**Break-up for capital cost considered by CERC**

Sl. No.	Particulars	Capital cost Norm for Solar PV project (Rs. Lakhs/MW)
1	PV Modules (@ Rs. 62/ US \$)	332.35
2	Land Cost	25
3	Civil and General Works	50
4	Mounting Structures	50
5	Power Conditioning Unit	45
6	Cables and Transformers	55
7	Preliminary and Pre-operative expenses IDC etc.	48.50
<b>8</b>	<b>Total Capital Cost</b>	<b>605.85</b>

As per the PV Insight Report dated 1<sup>st</sup> July, 2015, the following are the module prices:

Item	High USD / Watt	Low USD / Watt	Average USD / Watt
Silicon Solar Module	0.78	0.48	0.547
Thin Film Solar Module	0.79	0.47	0.591

The Commission notes that the cost of modules has come down from 0.52 USD/MWp obtained during December, 2014 to 0.48 USD/MWp in July, 2015. Considering the average cost at 0.50 USD/MWp and an exchange rate of Rs.62.877 per USD (average of six months i.e. from 1<sup>st</sup> January, 2015 to 1<sup>st</sup> July, 2015), the cost of solar PV modules works out to Rs.314.38 Lakhs per MW.

With the above cost of solar PV modules and considering the other components of the capital cost as determined by CERC, the capital cost for Solar PV plants will be as follows:

**Break-up for capital cost considered by KERC**

Particulars	FY16	FY17	FY18
Average Module cost-USD/Watt peak	0.50	0.50	0.50
6 Months average value of USD in Rs. as per RBI (01.01.2015 to 01.07.2015)	62.88	62.88	62.88
Cost of Solar Module in Rs./Watt	31.44	31.44	31.44
Cost of Solar Module in Rs. lakhs /MW	314.38	314.38	314.38
Land Cost @ Rs.5.00 Lakhs per acre (5Acres per MW)	25.00	25.00	25.00
Civil and General Works	50.00	52.50	55.13
Mounting Structure	50.00	52.50	55.13
Power Conditioning Unit	45.00	47.25	49.61
Evacuation Lines & Equipments	55.00	57.75	60.64
Preliminary and preoperative expenses IDC etc.,	48.50	50.93	53.47
<b>Total Capital Cost in Rs/MW</b>	<b>587.88</b>	<b>600.31</b>	<b>613.35</b>

Since the module prices are declining, the Commission has not considered any inflation in the price of module projected for FY17 and FY18. **The Commission has not considered any further reduction in price of the solar modules in FY17 and FY18 for the purpose of tariff determination so as to offer a reasonably longer stable tariff regime to the investors.** However, in respect of cost of other items, the Commission has considered an inflation factor of 5% per annum for estimating the capital cost for FY17 and FY18. The average capital cost for the period FY16 – FY18 will be Rs.600.00 lakhs / MW.

Accordingly, the Commission decides to consider capital cost of Rs.600.00 Lakhs per MW for the present control period for Solar PV plants which includes evacuation cost upto interconnection point.

As regards the capital cost for solar thermal power plants, since no new data is available and capital cost considered by CERC and other State ERCs are comparable with the current levels fixed by it, **the Commission retains the capital cost of Rs.12.00 Crores per MW for Solar thermal plants including evacuation cost upto interconnection point.**

**vi) Debt-Equity Ratio**

The Commission had proposed to adopt a Debt Equity Ratio of 70:30. Based on the Tariff Policy and the Industry norm, **the Commission decides to continue with the same ratio in the present tariff determination process.**

**vii) Operation & Maintenance Cost:**

CESC has suggested retaining 1.5% of capital cost as annual O & M expenses with an escalation of 5.72% for solar thermal and solar PV plants.

Sri M.R.C. Chouhan and others have submitted that, the O & M cost consisting of employee cost, A&G and R&M will always be rising year on year and hence there is no need to revise the existing O & M expenses.

Sri G.G. Hegde Kadekodi, Sirsi, has suggested to adopt O & M expenses of Rs.13.50 lakhs/MW and Rs.18.00 lakhs/MW for solar PV and solar thermal plants with an annual escalation of 6%.

M/s Hindustan Power, Delhi, have suggested to provide O & M expenses of Rs.13 lakhs/MW as considered by CERC with an escalation of 6.64%.

Prof. D P Sen Gupta, has agreed with CERC norms for O&M expenses and has suggested that the O&M cost be determined annually as there is rapid evolution of technologies and rapid decline in costs.

M/s Sun Edison has suggested to consider O & M expenses of Rs.13 lakhs / MW with annual escalation of 5.72% as considered by CERC.

BESCOM has proposed O & M expenses of 1.6% of the capital cost with 5.72% annual escalation.

**Commission's Decision:**

The operation and maintenance cost consists of employee cost, administrative and general expenses and Repairs & Maintenance expenses. The Commission in its Order dated 10<sup>th</sup> October, 2013 had considered O & M expenses of Rs.12.00 lakhs / MW for solar PV plants and Rs.18.00 lakhs / MW for solar thermal plants with an annual escalation of 5.72%.

It is noted that the CERC has considered O & M expenses of Rs.13.00 lakhs / MW for solar PV plants and Rs.17.72 lakhs / MW for solar thermal plants for FY 2015-16 with an annual escalation of 5.72%. The O&M expenses proposed by CERC of Rs.13 lakhs per MW works out to 2.14% of the capital cost for solar PV plants and Rs.17.72 lakhs per MW works out to 1.47% of the capital cost for Solar thermal plants.

Some of the stakeholders have suggested retaining 1.5% of capital cost as annual O & M expenses, with an escalation of 5.72% for solar thermal and solar PV plants. Others have suggested allowing O & M expenses of 0.75% to 1.5% of the capital cost for solar PV and 1.5% of the capital cost for solar thermal plants. As regards the rate of annual escalation, most of the stakeholders have suggested adopting 5.72% annual escalation.

The Commission is of the view that the O & M expenses considered by CERC appears to be very reasonable as it is based on the recent trends in the industry.



**Hence, the Commission decides to allow O & M expenses of Rs.13.00 lakhs / MW for solar PV plants and Rs.17.72 lakhs / MW for solar thermal plants for FY 2015-16 with an annual escalation of 5.72%.**

**viii) Auxiliary consumption:**

The Commission in its Order dated 10<sup>th</sup> October, 2013 had considered auxiliary consumption of 0.25% of the gross generation for solar photovoltaic plants and 8% for solar thermal plants.

CESC has suggested to disallow auxiliary consumption of 0.25% for SPV and to continue with auxiliary consumption of 8% for solar thermal plants.

Prof. D P Sengupta, submitted that while determining the tariff the Commission should take into consideration the energy loss of approximately 5-10% during the conversion of DC power to AC. Further, minimum quality and efficiency criteria should be prescribed for Balance of System devices.

Sri M.R.C. Chouhan and others have submitted that, the auxiliary consumption considered by the Commission in its Order dated 10<sup>th</sup> October, 2013 cannot be varied or re-determined as it depends on weather conditions, depositing of dust on panels and such other unforeseen natural eventualities.

M/s JUWI has requested to consider auxiliary consumption at 1% of energy generated.

M/s Hindustan Power, Delhi, have submitted that auxiliary consumption as measured in solar PV power plants ranges from 0.80% to 1.84%.

M/s Sun Edison has agreed with the proposal of providing 0.25% of total energy generation towards auxiliary consumption.

BESCOM has cited the auxiliary consumption recorded by three power plants namely M/s Azure Power, M/s Bhoruka Power and M/s Jindal Aluminium

wherein auxiliary consumption of 0.52% to 0.708% has been recorded during the period January, 2015 – April, 2015. Hence, auxiliary consumption of 0.5% is suggested for consideration.

**Commission's Decision:**

The Commission notes that most of the SERCs have not allowed auxiliary consumption for Solar PV Plants. The actual data on auxiliary consumption has not been made available by any of the stakeholders. The quality and efficiency criteria for balance of system devices vary with each equipment of each manufacturer and fixing such criteria is beyond the scope of this Order.

However, considering the submissions of the stakeholders in response to the discussion paper and that there are no strong grounds to review its current stand on this issue, **the Commission decides to continue with auxiliary consumption of 0.25% for solar photovoltaic plant and 8% for solar thermal plants.**

**ix) Interest and Tenure of Debt:**

The Commission had proposed to consider the tenure of debt as 10 years. The Commission had also proposed to review the rate of interest of 12.30% on debt reckoned currently at based on the prevailing interest rates applicable for solar power projects.

Sri M.R.C. Chouhan and others have submitted that, there is no need to review rate of interest provided for on debt and tenure of debt. M/s JUWI has suggested to consider rate of interest at 13.5% and tenure of debt at 12 years.

M/s PRDCL have submitted that, the interest rates charged by IREDA and PFC to low credit rated borrowers is 12.65% and 13% respectively. That, further the land owners would not be able to provide collateral security to lenders and

would not have strong credit background. Hence, they have suggested adopting interest rate of 13% for plants upto 3 MW capacity.

**Commission's Decision:**

The Commission notes that as per its Order dated 1<sup>st</sup> January, 2015, the tenure of loans for other renewable sources of energy has been fixed at 12 years. CERC has also considered debt repayment period as 12 years.

**The Commission therefore decides to consider loan repayment tenure of 12 years for the purpose of determination of tariff.**

As regards the allowable rate of interest on loan, the Commission notes that interest rate at 12.5% on loan has been allowed to the other renewable sources of energy. Considering the present SBI base rate of 9.70% effective from 8<sup>th</sup> June, 2015, **the Commission decides to allow 12.5% as interest on loan which is 280 basis points more than the present base rate to cover the additional rate that investors of solar projects may have to bear.**

**x) Working Capital and Interest on working capital:**

The Commission in its tariff Order dated 10<sup>th</sup> October, 2013 had considered two months receivables as working capital.

Sri M.R.C. Chouhan and others have submitted that, financial institutions charge marginally higher rate of interest for short term loans and hence interest on working capital would be proportionately higher. M/s JUWI has suggested to consider SBI rate plus 600 basis points or 14% as interest on working capital.

BESCOM has suggested to consider one month O & M expenses plus receivables equivalent to 1 ½ months and 15% of O & M expenses for maintenance spares as working capital with 12.5% interest on working capital.

**Commission's Decision:**

The Commission notes that a reasonable working capital has to be allowed for enabling the investor to sustain his operations. The Commission notes that payment security mechanism to generators is available in the form of Letter of Credit (LC) for recovering their monthly claims if not cleared in time. The payment for the energy generated in a month by the generator is thus effectively paid in the subsequent month by the distribution licensee.

**The Commission therefore decides to continue to allow two months' receivables as working capital which would be sufficient for sustaining the operational performance of the generator.**

As regards the interest on working capital, the Commission notes that, considering that the term of working capital loans being short, the interest rate would be at a higher rate than the interest rate chargeable for long term loans. The Commission, as per its Order dated 1<sup>st</sup> January, 2015 has allowed 13.25% as interest on working capital for other renewable sources of generation. **Hence, the Commission decides to allow 13.25% as interest on the working capital in respect of solar projects as well.**

**xi) Depreciation:**

The Commission had proposed 70% of the capital cost to be financed by debt component and the tenure of debt at 10 years. Also, the Commission had proposed to continue with annual depreciation at 7% for first 10 years to provide adequate depreciation to meet the loan repayment and annual depreciation at 1.33% for the balance period of 15 years.

Sri M.R.C. Chouhan and others have submitted that, the efficiency of the panels to generate power gets reduced and consequentially depreciation would increase. Hence, depreciation allowed needs to be reviewed.

BESCOM has suggested considering depreciation of 7% of 90% of the project cost for first 10 years as land cost is not depreciable.

**Commission's Decision:**

The Commission notes that the depreciation of 5.83% for the first 12 years has been allowed by it for all other renewable sources of energy. Similar depreciation has also been considered by CERC. **Hence, considering that it has reckoned debt tenure at 12 years, the Commission decides to allow depreciation at 5.83% for the first 12 years and 1.54% for the balance 13 years on the capital cost of the plant excluding land cost.**

**xii) Return on Equity:**

The Commission, in its Tariff Orders in respect of other renewable sources of energy, has allowed RoE of 16% and the actual tax component as a pass through. The Commission proposes to continue with the same for solar energy as well.

Sri M.R.C. Chouhan and others have submitted that, RoE as per the present Order could be continued.

BESCOM has suggested not to allow tax component for initial 10 years due to tax holiday and that MAT paid during initial 10 years be adjusted against regular tax after 10 years as per Section 115 JB of IT Act, 1961 and reimbursement, if any, should be addressed after 10 years.

**Commission's Decision:**

As considered for other renewable sources of energy, **the Commission decides to continue with the 16% RoE.** Any tax paid on the RoE is allowed as a pass through, limited to the amount of equity considered in this Order, which shall be claimed separately from the distribution licensees, duly furnishing proof of payment of such tax.

**xiii) Discount Factor:**

The discount 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 had proposed that it would be appropriate to consider weighted average cost of capital (WACC) as the discount factor.

Sri M.R.C. Chouhan and others have submitted that, the existing discount factor may be continued.

M/s Sun Edison has requested to clarify that the discount factor will be pre-tax WACC and not post-tax WACC.

**Commission's Decision:**

The Commission notes that the financing of capital cost is in the debt equity ratio of 70:30 respectively. Considering the cost of debt and cost of equity, it is considered that the weighted average cost of the capital employed is appropriate for determining the discount factor. Since the Commission has allowed the actual tax paid by the generator as a pass through annually limited to the amount of equity considered in the Order, the computation of discount factor does not include the tax component. **Hence, considering 70% of the capital cost at 12.5% interest and 30% of equity at 16% of RoE, the Commission decides to allow discount factor of 13.55%.**

**xiv) Other issues:**

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

The Commission decides to continue with the following mechanism of sharing of the CDM benefits between the generating company and the beneficiaries as follows:

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

**(b) Grid Connectivity:**

The Commission decides that, the STU shall arrange necessary facilities to evacuate power from the interconnection point. Further, STU/ESCOMs shall not collect any network augmentation charges towards system augmentation beyond the interconnection point. The developer shall be responsible for providing evacuation facility upto the interconnection point as defined in the PPA.

The grid connectivity shall be arranged by the distribution licensee in accordance with the prevailing CEA (Technical Standards for Connectivity to the Grid) Regulations 2007, CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations 2012 and any other related Regulations to be notified by CEA and KERC Grid Code as amended from time to time.

**(c) Applicability of Merit Order dispatch:**

All grid connected solar power plants shall be considered as 'Must Run' and shall not be subjected to Merit Order Dispatch principles.

**(d) Applicability of Wheeling and Banking Charges and Cross Subsidy Surcharge:**

The Wheeling, Banking and Cross Subsidy surcharge shall be applicable as per Commission's Order dated 18<sup>th</sup> August, 2014.

**(e) Comments on Tariff and other general comments:**

Sri Ramesh Babu, has submitted that considering the exchange rate of Rs.63.82 / US \$, the capital cost would be less than Rs.5.5 Crores / MW and the tariff would be between Rs.6.50 and Rs.6.00 / unit. Hence, the present tariff is more by about Rs.1.45 / unit which would work out to Rs.1848.75 Crores for 300 MW solar power capacity allocated to farmers for 25 years. He has suggested to fix tariff in the range of Rs.6.00 to Rs.6.50 / unit.

M/s JUWI have submitted that projects of 1 – 3 MW capacities would incur higher project costs because of the smaller size and higher cost of infrastructure development including laying of transmission lines above 10 KMs. Hence, the existing tariff of Rs.8.40/kWh only will make the project viable.

Sri Krishitosh has submitted that the tariff should be attractive for investors for encouraging investment in solar power generation. He has submitted that the financial institutions are not lending at interest rates below 12%. He submitted that a tariff in the range of Rs.8.00 to Rs.9.00 per unit for a life of 25 years alone would make the smaller plants of 1 – 3 MW capacity viable.

Sri Kirthi Kanth Acharya, Mallige Education Foundation has requested the Commission not to apply the proposed tariff for plants that are already taken up under farmers' quota. He submitted that the capital cost for lower capacity plants of 3MW and large solar plants of 140MW cannot be the same. He submitted that the reverse bidding rates of Rs.6.71 to Rs.7.12 per unit discovered by KREDL pertains to large scale plants to be developed by big investors. He further pleaded that unlike large plants, small plants cannot be financed easily. He submitted copies of the few quotations in support of his submission that the capital cost should be considered at Rs.7.00 to Rs.7.50 Crores per MW. He further requested the Commission to retain the existing tariff for the plants proposed under farmers' and institutions' quota envisaged in the State's Solar Policy.



Sri Dinesh Kagathi, PRDCL has submitted that the farmers' credit rating being low, interest on loans would be higher at 13%. He further suggested that tariff should be determined separately for farmers' / smaller projects with capacity of less than 3MW.

KREDL has concurred with the Commission's proposal in the draft discussion paper.

Sri Rajashekar S Nadagouda, Shri. A.R. Sonnad and others have suggested that the tariff of Rs.6.66 to Rs.8.22/unit discovered by KREDL in the reverse bidding is true for large generators and the same should not be equated to farmers and that in the interest of farmers economy and in line with the Government's Policy, it is requested not to reduce the tariff from the current level of Rs.8.40 / unit.

Shri. A.R. Sonnad has submitted that since interest on working capital is around 1.5% - 2% per month a cash rebate of more than 2% is not economically viable.

Sri Ulhas Sidramappa Arakeri and Sri Sunil Roopsingh Rathod, Vijayapura, have stated that a rebate of 2% if the bill is paid on the day it is submitted should be allowed. He has also requested not to revise the tariff of Rs.8.40/unit.

M/s AVI Solar Energy Pvt. Ltd., Bangalore, have suggested that the tariff of below Rs.7/unit is not financially viable.

M/s Ravindra Energy Limited, Mumbai and Sri Pandu Ramappa Dasar, Gokak, have suggested that any change in tariff determined by the Commission should be applicable to PPAs signed after the publication / notification of the re-determined tariff and the same should not be mandated in respect of prior PPAs.

Sri Muniraju, Varthur, has requested to retain tariff of Rs.8.40/unit for solar power plants installed by farmers.

Sri B.G.Rudrappa, Bangalore has suggested to study the impact of solar capacity addition. He has submitted that, uncontrolled addition solar capacity could pose serious problems in operating the grid. He has further submitted that it is necessary to review the tariff as the cost has come down to Rs.6 to Rs.7/unit as quoted in the article "The 100 GW Headache" published in Business Today dated 10<sup>th</sup> May, 2015.

M/s Hindustan Power, Delhi, have suggested to retain the control period as per the Order dated 10<sup>th</sup> October, 2013.

**Commission's Decision:**

The Commission notes that the above comments made by stakeholders mainly pertain to tariff, applicability and the control period. The Commission has made use of all the available information/inputs in the present proceedings and accordingly proceeds to re-determine the tariff. Claims for higher capital cost outlay because of locational disadvantage, low credit rating resulting in higher interest rate for debt, faster degradation of solar panels etc. can be considered to be project specific issues and cannot be relied on to determine generic tariff. The Commission has endeavoured to determine tariff on generic basis, since determination of tariff on a case to case basis would not be practicable and also not desirable. The applicability and the control period of the tariff now determined has been specified earlier in this Order.

As regards the impact of solar power capacity addition on the grid operation, the Commission is of the view that the same needs to be studied and decision taken accordingly. This does not fall under the scope of this Order.

The comments / suggestions on issues not relevant to the tariff determination process have not been discussed, as the same are beyond the scope of this Order.

## 5. Abstract of cost parameters approved by the Commission:

Based on the above decisions of the Commission, the following is the abstract of the parameters considered for determination of tariff:

Particulars	Solar PV	Solar Thermal
Capital Cost/MW- Rs. Lakhs	600	1200
Debt: Equity Ratio	70:30	70:30
Debt-Rs. Lakhs/MW	420	840
Equity- Rs. Lakhs/MW	180	360
Debt Repayment Tenure in Yrs.	12	12
Interest charges on Debt-%	12.50%	12.50%
Capacity Utilisation Factor (CUF)	19%	23%
Degradation Factor	0.5% of net generation after 4 <sup>th</sup> year	-
ROE-%	16%	16%
Discount Factor -%	13.55%	13.55%
Auxiliary consumption-%	0.25%	8%
O & M expenses in Rs. Lakhs per MW	13.00	17.72
O & M Escalation p.a.	5.72%	5.72%
Working Capital	2 months receivables	2 months receivables
Interest on Working Capital-%	13.25%	13.25%
Depreciation for first 12 yrs	5.83%	5.83%
Depreciation for next 13 yrs	1.54%	1.54%

**6. Tariff for grid connected Solar PV and Solar Thermal power plants:**

On the basis of the approved parameters, the Commission hereby approves the following tariff:

Type of Solar Plant	Approved Tariff in Rs/Unit
Solar PV Power Plants	6.51
Solar Thermal Power Plants	10.85

**This Order is signed and issued by Karnataka Electricity Regulatory Commission on this 30<sup>th</sup> day of July, 2015.**

Sd/-  
**M.K.Shankaralinge Gowda**  
Chairman

Sd/-  
**H.D.Arun Kumar**  
Member

Sd/-  
**D.B.Manival Raju**  
Member

**Annexure**

**LIST OF STAKEHOLDERS WHO HAVE SUBMITTED COMMENTS / SUGGESTIONS**  
**ON THE DISCUSSION PAPER DATED 5<sup>th</sup> MAY, 2015 FOR RE-DETERMINATION OF TARIFF**  
**FOR SOLAR POWER GENERATION**

<b>Sl. No.</b>	<b>Name and Address</b>
1	Sri B.G.Rudrappa, Former Chairman, KEB, Member Advisory Committee, KERC.
2	The Managing Director, CESC, Mysore
3	Sri V.Muniraju, No.1, Kariyammana Agrahara, Bellandur Post, Varthur Hobli, Bangalore – 560 103
4	Sri M.R.C. Chouhan, Smt. Pallavi S, Smt.K.H.Lakshamma, Smt.Jyothi Chouhan
5	Sri Ramesh Babu, Spokesperson, JD(S), Bangalore
6	Sri Girish Shivakumar, JUWI, India Renewable Energies Pvt. Ltd., Bangalore.
7	The Managing Director, KREDL, Bangalore
8	Sri Rajashekar S Nadagouda, Plot No.5 & 6, Nadagouda Nivas, Shivayogi Nagar, Ashram Road, Vijayapur.
9	Sri Ulhas Sidramappa Arakeri, Arakeri House, Chalukyanagar, Solapur Road, Bijapur
10	Sri Ashoka, D.M, AVI Solar Energy Pvt. Ltd., 146/4, Shanthala Plaza, 2 <sup>nd</sup> Floor, 8 <sup>th</sup> Main, 14 <sup>th</sup> Cross, Malleswaram, Bangalore -560 003.
11	Sri Sunil Roopsingh Rathod, Bijapur
12	M/s PRDCL, 5, 11 <sup>th</sup> Cross, 2 <sup>nd</sup> Stage, West of Chord Road, Bangalore – 560 086
13	Sri J.Suresh Kumar, Chief Executive Officer, Ravindra Energy Ltd., 23, 2 <sup>nd</sup> Floor, Madhuli CHS, Behind Shiv Sagar Estate, Dr.Anne Besant Road, Worli, Mumbai – 400 018.

14	Sri Pandu Ramappa Dasar, Kulgod Village, Gokak Taluk, Belguam District.
15	Sri PHK Srinivasa Reddy, M/s Sailis Projects Pvt. Ltd., Habsiguda, Hyderabad
16	Sri G.G.Hegde Kadekodi, President, Balakedarara Hitarakshaka Sangha,C.P.Bazar, Sirsi – 581 401.
17	Sri Ashish Nandan, Manager – Regulatory Affairs, Hindustan Clean Energy Ltd., 616A, (16A, Sixth Floor), Devika Tower, Nehru Place, New Delhi – 110 019.
18	M/s Sun Edison Energy India Pvt. Ltd., Chennai
19	The Managing Director, BESCO, Bangalore
20	A R Sonnad, Bijapur
21	Name & address not furnished
22	Prof. D.P. Sen Gupta, National Institute of Advance Studies, Bangalore

**LIST OF STAKEHOLDERS WHO HAVE SUBMITTED ORAL COMMENTS / SUGGESTIONS  
DURING PUBLIC HEARING HELD ON 2<sup>nd</sup> JULY, 2015**

1. Sri Kirthi Kanth Acharya, Mallige Education Foundation
2. Sri Krishitosh, New Thippasandra, Bangalore
3. Mrs. Archana Bhat, AWI Solar Energy,
4. Sri Dinesh Kagathi, PRDCL
5. Sri. Ramesh Babu, Spokesperson, Janata Dal (S)
6. Dr. Chakravorthy, National Institute for Advance Studies
7. Sri, Yathiraju, Farmer, Chitradurga,