



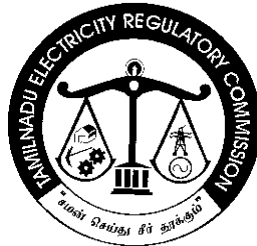
**TAMIL NADU ELECTRICITY REGULATORY  
COMMISSION**

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**Tariff Order for projects covered  
by Jawaharlal Nehru National  
Solar Mission**

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**Order No 1 of 2010 dated 27-5-2010**



**BEFORE THE TAMIL NADU ELECTRICITY REGULATORY COMMISSION**

**PRESENT:**            Thiru. S. Kabilan            -            Chairman

**Order No.1/2010, dated 27-5-2010**

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**In the matter of :**    Tariff Order for projects covered by Jawaharlal Nehru  
National Solar Mission.

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In exercise of the power conferred by Sections 181, 61 (h) and 86 (1) (e) of the Electricity Act 2003, (Act 36 of 2003), read with the National Electricity Policy, the Tariff Policy and the Power Procurement from New and Renewable Energy Sources Regulations, 2008 of the Commission after consulting the State Advisory Committee as per Section 88 on 18-5-2010 and after considering the views of all the stakeholders, the Commission passes this Tariff Order on solar energy.

**Vacant  
(Member II)**

**Long leave  
(Member I)**

**Sd.....  
(S. Kabilan)  
Chairman**

**(By order of the Commission)**

**R. V. Rajah  
(Secretary)**

**Tariff Order No.1 of 2010 dated 27-5-2010**

**Tariff Order for projects covered by Jawaharlal Nehru  
National Solar Mission**

**1. Scope of this Order**

1.1. The Government of India launched the Jawaharlal Nehru National Solar Mission in November 2009 to promote ecologically sustainable growth while addressing the country's energy security challenge.

1.2. The Mission's targets are:-

- (a) To create an enabling policy framework for the deployment of 20,000 MW of solar power by 2022.
- (b) To ramp up capacity of grid-connected solar power generation to 1000 MW within three years – by 2013; an additional 3000 MW by 2017 through the mandatory use of the renewable purchase obligation by utilities backed with a preferential tariff. This capacity can be more than doubled – reaching 10,000MW installed power by 2017 or more, based on the enhanced and enabled international finance and technology transfer. The ambitious target for 2022 of 20,000 MW or more, will be dependent on the 'learning' of the first two phases, which if successful, could lead to conditions of grid-competitive solar power. The transition could be appropriately up scaled, based on availability of international finance and technology.
- (c) To create favourable conditions for solar manufacturing capability, particularly solar thermal for indigenous production and market leadership.
- (d) To promote programmes for off grid applications, reaching 1000 MW by 2017 and 2000 MW by 2022 .

- (e) To achieve 15 million sq. meters solar thermal collector area by 2017 and 20 million by 2022.
- (f) To deploy 20 million solar lighting systems for rural areas by 2022.

1.3. As a part of the Mission, the Ministry of New and Renewable Energy, Government of India have proposed to develop solar PV capacity of 100 MW as follows:-

<b>S.No.</b>	<b>Project Category</b>	<b>Capacity limit</b>
1	Projects connected at HT level of distribution network with installed capacity of 1 MW and upto 3 MW	80 MW
2	Projects connected at LT level of distribution network with installed capacity lower than 1 MW.	20 MW

This Tariff Order covers the projects connected at HT level of distribution network (below 33 kV) with installed capacity of 1 MW and upto 3 MW with a total capacity limit of 80 MW. This Tariff Order would apply to the projects commissioned within Tamil Nadu out of this 80 MW.

## **2. Generalised Tariff Order for Solar Projects**

The Commission would come up with a generalized tariff order for solar projects as and when the Government of Tamil Nadu finalizes the State Solar Mission.

## **3. Order No.1 of 2010**

The Government of India has announced a cut of date of 1<sup>st</sup> July 2010 for registration of solar photovoltaic projects upto capacity of 80 MW. As the deadline has to be met, the Commission floated a concept paper on 4-5-2010 on the website of the

Commission inviting comments and suggestions upto 20-5-2010. The State Advisory Committee of the Commission considered the concept paper on 18-5-2010. Taking into account the views expressed in the Advisory Committee and the comments received in response to the concept paper, the Commission has finalised this Tariff Order. The Distribution Licensee would enter into a power purchase agreement with those solar PV generators from Tamil Nadu who are selected by the Government of India within the over all capacity of 80 MW. The difference between the tariff determined by the Central Electricity Regulatory Commission for solar PV power and the base rate of Rs.5.50 per unit with 3% annual escalation would be available as generation based incentive to the Distribution Licensee through Indian Renewable Energy Development Agency (IREDA). The difference between the tariff for solar PV power fixed by this Commission in Order No.1 of 2010 and the generation based incentive would be the cost of solar PV power to the Distribution Licensee.

#### **4. Components of tariff**

The following are the components of tariff for solar energy:-

1. Capital Cost
2. Capacity utilization factor
3. De-rating
4. Debt-equity ratio
5. Term of loan
6. Rate of interest
7. Interest on Working Capital
8. Return on equity
9. Life of plant and machinery
10. Rate of depreciation
11. Operation and maintenance expenditure
12. Auxiliary Consumption
13. Accelerated Depreciation Benefit

## 5. Capital Cost

5.1. The cost of a solar power project is mainly dependent on the cost of PV modules / plant and machinery, technology adopted, location of the site and capacity. There is a limited experience in this area of generation. With further development in technology and economies of scale, production costs for solar energy projects may decline. The Indian Renewable Energy Development Agency Limited (IREDA) has recommended a capital cost of Rs.18 to 20 Crores per MW for Solar PV thin film technology and Rs.22 to 25 Crores per MW for Solar PV single / multi crystalline technology. The Central Electricity Regulatory Commission in their Order dated 25.02.2010 against Petition no. 13/2010 have adopted a capital cost of Rs.16.90 Crores per MW for Solar PV project. Commission is of the opinion that the capital cost adopted by CERC is reasonable and the same has been adopted in this order.

5.2. The CERC in their Terms and Conditions for Tariff determination from Renewable Energy Sources Regulations, 2009 has stipulated the following norms for capital cost:

*“The norms for the Capital cost as specified in the subsequent technology specific chapters shall be inclusive of all capital work including plant and machinery, civil work, erection and commissioning, financing and interest during construction, and evacuation infrastructure up to inter-connection point.”*

5.3. The Hon'ble Appellate Tribunal for Electricity in its judgment dated 08-01-2010 against the Appeal No. 93/2009 filed by TNEB has ruled that a generating company is liable to pay the TNEB the Infrastructure Development Charges (IDC) fixed by the TNEB for establishing, operating and maintaining the sub-stations on behalf of the generators to do the evacuation work.

5.4. Therefore, the Commission decides that the Infrastructure Development Charges (IDC) of Rs.25.75 lakhs per MW should be loaded to the capital cost. Accordingly, the capital cost is refixed as Rs.17.1575 crores per MW.

## **6. Capacity utilization factor (CUF)**

CUF is the ratio of actual energy generated by the Solar PV project over the year to the equivalent energy output at its rated capacity over the yearly period. CUF for Solar PV project depends on solar radiation and number of clear sunny days. CUF is also depends on site specific parameters like ambient conditions, conversion efficiencies of PV cell, etc. The TEDA has reported a CUF of 15 to 18%. The Indian Renewable Energy Development Agency Limited (IREDA) has recommended a CUF of 15 to 20%. M/s. RL Clean Power Pvt. Ltd has stated that the Plant Performance Factor (PPF) of the plants commissioned in Punjab and Karnataka are 16% and 17% respectively. M/s. Century Consulting Group pointed out that achievement of 19% CUF is difficult. M/s. Lanco Solar Private Limited has requested the Commission to consider a CUF of 16.8% for tariff calculation. M/s. Reliance Industries Limited stated that a CUF of 15% - 16% will be more practical for Indian conditions. Tata BP solar has recommended a CUF of not more than 17%. CERC in their Terms and Conditions for Tariff determination from Renewable Energy Sources Regulations, 2009 have adopted a CUF of 19% for Solar PV projects after detailed analysis. The CERC have considered average number of clear sunny days of around 300 and daily average global solar radiation of around 5.8 kWh/Sq.mtr/day for calculation of CUF. As per the solar radiation map provided by the National Renewable Energy Laboratory, USA in their website, the maximum solar radiation in Tamil Nadu is 5.8 kWh/Sq.mtr/day. The solar Radiation Handbook, 2008 of MNRE has projected annual solar insolation in Chennai as 5.37. Considering the above, the Commission adopts a CUF of 19% in this order as adopted by the CERC.

## **7. De-rating**

De-rating factor has not been foreseen by other State Commissions / CERC. It is natural that any material used in the PV module for energy conversion, loses its efficiency due to aging. Being a new area without information on past performance parameters, fixation of de-rating factor for a Solar PV Plant can only be an approximation. IREDA has recommended a de-rating factor of 0.5 to 1% per annum. M/s. Lanco Solar Private Limited has stated that all solar PV modules degrade at 0.50% every year and requested the Commission to consider de-rating factor of 0.50% for the tariff calculation. M/s. Reliance Industries Limited has stated that an annual de-rating factor of 0.5% to 1% should be considered for the PV modules for the first 10 years to account for decreased adherence of contacts or corrosion (usually caused by water vapor), metal migration through the p-n junction, anti reflection coating deterioration etc. The Tata BP solar recommended a de-rating factor of 1% from the first year itself. The Commission decides to adopt 1% de-rating factor for every year after 10 years of operation for solar PV Power Plants.

## **8. Debt: Equity Ratio**

The Tariff Policy lays down a debt equity ratio of 70 : 30 for power projects. The Commission has adopted this ratio in the Tariff Regulations 2005 as well as in the earlier renewable energy tariff orders. The Commission decides to retain the same ratio for this order.

## **9. Term of Loan**

The Commission fixed a tenure of ten years with moratorium of one year in its Tariff Order Nos.1, 2 and 3 of 2009 based on the consideration that term loans sanctioned by IREDA stipulated this tenure. The Commission decides to retain the same tenure in this order.

## **10. Rate of interest**

CERC has considered the long-term PLR of State Bank of India plus 150 basis points as adequate. TEDA has recommended interest rate of 12% with repayment period of 7-8 years. M/s. Century Consulting Group has pointed out that the interest rate on loan and working capital need to be increased by 1%, i.e. 13%. M/s. Lanco Solar Private Limited has stated that the loans with interest rates of 12% are available and accessible to only a few developers and commonly available loans are with interest rates of 13.50 to 14%. The Commission in its Order Nos.1, 2 and 3 of 2009 adopted an interest rate of 12%. The Commission considers that interest rate of 12% is reasonable.

## **11. Interest on Working Capital**

11.1. The Central Electricity Regulatory Commission has included the following components in working capital in their Regulations, 2009:

- (i) Operation and Maintenance expenses for one month;
- (ii) Maintenance spares @ 15% of the O&M expenses,
- (iii) Receivables equivalent to 2 months of energy charges for sale of electricity calculated on the normative CUF;

11.2. CERC fixed an interest rate equivalent to average State Bank of India short term PLR during the previous year plus 100 basis points. Commission in its latest order Nos. 2 and 3 of 2009, receivables equivalent to one month of energy charges was included in the working capital as the distribution licensee has to make payment to the generator within 30 days of receipt of the bill. Regarding the components of the working capital, it is the general opinion that the spares required for solar PV project is very low (or practically negligible) compared with the solar thermal projects.

11.3. Considering the above, Commission

decides to adopt an interest rate of 12% on working capital as considered in order No. 2 and 3 of 2009 by the Commission along with the following working capital component:

- (i) Operation and Maintenance expenses for one month;
- (ii) Maintenance spares @ 1% of the O&M expenses and
- (iii) Receivables equivalent to 1 month of energy charges for sale of electricity calculated on the normative CUF.

## **12. Return on Equity**

The Tariff Regulations of the Commission stipulates 14% post tax RoE for conventional fuel based generating stations. With the objective of promoting renewable energy, Commission in its NCES Tariff Order Nos.1, 2 and 3 of 2009 have considered 19.85% pre-tax return on equity from 01-04-2009. The CERC has adopted RoE of 19% pre tax for the first ten years and 24% for the remaining 15 years for solar PV projects. The Commission decides to adopt 19.85% pre-tax return on equity for this order.

## **13. Life of plant and machinery**

The Commission decides to consider the solar PV plant life of 25 years as considered by CERC in their Terms and Conditions for Tariff determination from Renewable Energy Sources Regulations, 2009.

## **14. Rate of Depreciation**

The CERC's regulations recommended 'Differential Depreciation Approach' over loan tenure and period beyond loan tenure over useful life computed on 'Straight Line Method'. It is proposed to adopt the rate prescribed in the CERC's regulation, i.e. depreciation rate of 7% for the initial 10 years and 1.33% for the remaining years.

**15. Operation and Maintenance expenses**

The O&M expense includes the expenditure on manpower, repairs, spares, consumables, insurance and overheads. TEDA has suggested a O&M charges of 0.5% of the capital cost. Commission decides to adopt the rates prescribed in the CERC regulation. i.e. Rs.9.515 Lakhs per MW for the first year of the Control period (2010-11) and shall be escalated at the rate of 5.72% per annum for the remaining periods.

**16. Auxiliary Consumption**

The auxiliary consumption for solar PV power plant is to be considered to meet the auxiliary power requirement for equipments/devices for cooling of the power conditioning units, lighting of office/station yard, water sprinklers, monitoring and control units, communication services etc. Commission considers 2% of auxiliary consumption is reasonable for solar PV power plants.

**17. Accelerated Depreciation Benefit**

For the projects availing the benefit of accelerated depreciation as per applicable income tax rate @ 33.99% (30% IT rate+ 10% surcharge +3% Education cess) has been considered. For the purpose of determining net depreciation benefits, depreciation @ 5.28% as per straight line method (Book depreciation as per Companies Act, 1956) has been compared with depreciation as per income tax rate i.e. 80% of the written down value method and depreciation for the first year has been calculated at the rate of 50% of 80% i.e 40%, since it is assumed that the project is capitalized during the second half of the financial year. Tax benefit has been worked out as per normal tax rate on the net depreciation benefit. Also, the per unit levellised accelerated depreciation benefit has been computed considering the weighted average cost of capital as discount factor.

## **18. Related other issues**

The following issues related to solar power generation are considered:

1. CDM benefits
2. Reactive power charges
3. Startup power/ stand by power to generators
4. Harmonics
5. Application fees and agreement fees
6. Billing and payments
7. Payment security to the generators
8. Metering
9. Evacuation of solar power
10. Energy purchase agreement
11. Control Period

## **19. CDM benefits**

19.1. The Commission in its tariff orders 1, 2 and 3 of 2009 specified the following formula for sharing of CDM benefits.

*“CDM benefits should be shared on gross basis starting from 100% to developers in the first year and thereafter reducing by 10% every year till the sharing becomes equal (50:50) between the developer and the consumer in the sixth year. Thereafter, the sharing of CDM benefits will remain equal till such time the benefits accrue.”*

19.2. The Commission adopts the same formula in this order.

## **20. Reactive power charges**

Commission has proposed to adopt the rate specified in Indian Electricity Grid Code for reactive power charges.

**21. Startup/stand by power to generators**

Considering the costly solar power, the Commission decides to adopt the charges prescribed in order No. 2 dated 15-05-2006 for startup/stand by power to SPGs.

**22. Harmonics**

Since the SPGs use inverters for power conversion, they are prone to generate harmful harmonics. Therefore, SPGs shall take necessary steps to restrict the harmonic generation within the limit prescribed by the CEA Standards for connectivity to the grid Regulations, 2007.

**23. Agreement fee**

The agreement fee for Energy Purchase Agreement has been fixed at Rs.2000 per MW or part thereof. As regards the Energy Purchase Agreement, the TNERC – Fees and Fines Regulations 2004 prescribes Rs.2000 per MW or part thereof as the fees for approval of Power Purchase Agreement by the Commission as against Rs.2500 per MW or part thereof leviable for conventional power plants. This fee shall be collected by the licensee and passed on to the Commission.

**24. Billing and payment**

The generator shall raise a bill every month for the net energy sold after deducting the charges for start up / stand by power and reactive power. The distribution licensee shall make payment to the generator within 30 days of receipt of the bill. Any delayed payment beyond 30 days is liable for interest at the rate of 1% per month.

**25. Payment security to the generators**

The National Tariff Policy calls for adequate and bankable security arrangements to the generating companies. Therefore, the Commission has decided to impose a penalty of 1% per month for delayed payment by the licensee which would serve the ends of justice.

**26. Metering**

The Commission decides that metering and communication shall be in accordance with the following:

- (1) Central Electricity Authority (Installation and Operation of Meters) Regulations 2006
- (2) Tamil Nadu Electricity Distribution Code 2004
- (3) Tamil Nadu Grid Code 2004
- (4) Tamil Nadu Electricity Intra State Open Access Regulations 2005

**27. Evacuation of solar power**

27.1. With regard to evacuation facilities, the regulation 3 of the Commission's Power Procurement from New and Renewable Sources of Energy Regulations, 2008 specifies as follows:

*"3(3) Evacuation facilities shall be provided by the State Transmission Utility (STU) /Distribution licensee as per the Commission's Intra State Open Access Regulations 2005, Central electricity Authority (Technical Standards for connectivity to the Grid) Regulations, 2006 and Tamil Nadu Electricity Grid Code. The cost of interfacing lines, switch gear, metering, protection arrangement and related other equipments up to the interconnection point shall have to be borne by the generators, but the work shall be executed by STU/distribution licensee. The developer may be permitted to execute the works as per the terms and conditions of the STU/Licensee.*

*Provided that, in the case of sale of entire power to the distribution licensee by any new and renewable source based generator, the cost of interfacing lines up to the interconnection point shall have to be borne only by the STU/ distribution licensee.*

*Provided further that in case where the new and renewable source based generator referred to in the first proviso who has entered into an EPA with the distribution licensee referred to therein for the sale of entire power to the said distribution licensee decides to use such power agreed to be sold to the said distribution licensee, for his captive use or for sale of such power to a third person or to a distribution licensee other than the distribution licensee referred to above before the expiry of the period referred to in such EPA, then he shall be bound to reimburse the depreciated (Written down value) cost of interfacing lines to the distribution licensee with whom he has executed such EPA, before the wheeling of power to his captive use or sale to third person or distribution licensee other than the distribution licensee with whom the said EPA has been executed by him”*

27.2. The Hon'ble Appellate Tribunal for Electricity has ruled in its judgment dated 08-01-2010 against the Appeal No. 93/2009 filed by TNEB as follows:

*“12. As indicated above, the mandate of Section 10 (1) of the Act can not be over looked, since it is the bounden duty of the generating companies to establish, operate and maintain the sub-stations. If the evacuation work after the inter connection point is carried out by the generators as per Section 10 (1) and bring the 110 KV inter connection line or 230 KV inter connection line, as the case may be, to connect the same to the TNEB's 110 KV or 230 KV grid, then the TNEB will have to take care of the evacuation work beyond 110 KV or 230 KV inter connection point by installing a bulk at the inter connection point. In view of the above situation, the expenditure has been incurred by the TNEB for establishing, operating and maintaining the sub-stations on behalf of the generators to do the evacuation work up to the inter connection point. The Generating Company is liable to pay the said expenditure to the TNEB in the name of IDC fixed by the TNEB through various circulars as per the mutual arrangement and mutual agreement between the parties.*

*13. In view of the above, the impugned order dated 19.9.2008 is incorrect in law and therefore the same is liable to be set aside. Accordingly set aside. The TNEB is entitled to continue to collect IDC from the generators so long as the facility is availed of by the generators, as per the circular.”*

27.3. Therefore, a generating company is liable to pay the Infrastructure Development Charges (IDC) of Rs.25.75 lakhs per MW to the TNEB for establishing, operating and maintaining the sub-stations.

27.4. The Commission also prescribes the following procedure for creation of evacuation facilities:

- (a) STU / Distribution licensee shall within 30 days of receipt of application from solar power generators (SPG), intimate whether the SPGs can be connected to the grid to inject power without further system strengthening.
- (b) If further system strengthening is essential, the results of study conducted by the STU / Distribution licensee based on the request of SPGs shall be intimated within ninety days of such request of SPGs
- (c) Interconnection of SPGs to the grid based on system studies shall be established within six months at the latest.
- (d) Clearances, approvals, certificate, if any, required by SPGs shall be issued within a month time.
- (e) The STU / Distribution licensee is not liable to pay any compensation to the generator for deemed generation benefits in case the STU/Distribution licensee is unable to evacuate the power due to the reasons which are beyond his control.

**28. Energy purchase agreement (EPA)**

The format of the Energy Purchase Agreement (EPA) shall be evolved by the Commission after discussion with SPGs and the distribution licensee within a month of this order. The agreement period shall be co-terminus with the life of the project. The

distribution licensee shall execute the Energy Purchase Agreement within the period stipulated by Government of India. The parties to the agreement may be given the option of exiting in case of violation with three months notice to the other party.

**29. Control period**

Since solar power generation is still in its infant stage, fixing of longer control period is not advisable. With regard to tariff Review Period / Control Period, Regulation 6 of Regulations on “Power Procurement from New and Renewable Sources of Energy, 2008” specifies the following:

*“The control period may ordinarily be **two years**. When the Commission revisits the tariff and allied issues after the control period, the revision shall be applicable only to the generator of new and renewable energy sources commissioned after the date of such revised order”*

Therefore, the Commission decides that the control period of this Order shall extend up to 31-5-2012.

**30. Solar power tariff**

Solar energy tariff is computed with reference to the determinants listed in para (4) of this order. The cost plus single part levellised tariff for 25 years works out to Rs 18.45 per kWh and the benefit of Accelerated Depreciation (if availed) works out to Rs 4.11 per kWh. Therefore, the net applicable tariff (upon adjusting for accelerated depreciation benefit if availed) works out to Rs 14.34 per kWh as against the tariff of Rs.14.95 per kwh determined by CERC.

**Vacant  
(Member II)**

**Long leave  
(Member I)**

**Sd.....  
(S. Kabilan)  
Chairman**

**(By order of the Commission)**

**R. V. Rajah  
(Secretary)**