

**BEFORE THE GUJARAT ELECTRICITY REGULATORY COMMISSION  
AHMEDABAD**

**Draft Order No. 3 of 2009**

**IN THE MATTER OF DETERMINATION OF TARIFF FOR PROCUREMENT OF POWER BY THE DISTRIBUTION LICENSEES AND OTHERS FROM SOLAR ENERGY PROJECTS**

In exercise of the powers conferred under sections 61(h), 62 (1)(a) and 86(1)(e) of the Electricity Act, 2003 (36 of 2003) and all other powers enabling it in this behalf, the Gujarat Electricity Regulatory Commission (hereinafter referred to as “the Commission”) proposes to determine the tariff for procurement of power from Solar energy projects by Distribution Licensees and Others in Gujarat.

**1.0 Background**

**1.01 Potential for Solar Power in India**

India receives solar energy equivalent to nearly 5,000 trillion kWh/year, which is equivalent to 600 GW- far more than the country’s total energy consumption today. But India utilizes solar energy to a negligible extent. Solar applications can be broadly divided into grid-connected and off-grid. Considering the potential for solar power, grid connected electricity generation projects need to be promoted by giving preferential tariff and other facilities. Broadly, solar electricity generation uses two types of technologies: photovoltaic (SPV) and solar thermal technology.

India receives solar radiation of 4.6 to 6.4 kWh/m<sup>2</sup> for 300 to 330 days in a year: Most part of the Gujarat receive solar radiation daily in the range of 5.6 to 6.0 kWh/m<sup>2</sup>. In fact Saurashtra and North Gujarat regions receive solar radiation of 5.8 to 6.0 kWh/m<sup>2</sup>. The power generation potential for India using solar PV technology is estimated to be about 20 MW/km<sup>2</sup> and that using solar thermal generation about 35 MW/km<sup>2</sup>. Further, this estimated potential is at current levels of technology efficiency. If the technology is improved, then the potential could increase significantly. Solar energy systems do not require any fuel and, therefore, the running costs are lower. The other advantage of



solar energy systems is that the systems are modular, long-lasting, reliable and require less maintenance.

The Government of India has constituted a solar mission (one of a series of missions) as a part of the efforts to mitigate the effects of global warming and climate change. The solar mission is working on a long-term policy for development of solar energy in India. Therefore, the Government of India and State Governments are making efforts to develop this abundant source of power.

## **2.0 Feed-in tariffs**

Countries such as Germany, Spain and the USA are leaders in developing technology for solar based electricity generation. This development has become possible in the above countries due to feed-in tariff decided by the authorities concerned which is comparatively higher than the cost of generation from other sources.

The costs of solar energy are decreasing since the technology was first introduced to the market. Even then, in most cases, solar energy cannot yet compete with electricity generated from fossil fuels. Though it is expected that prices of electricity generated from fossil fuels would keep rising, it is still very important to maintain a strong momentum in bringing down the costs of solar energy. Till such time, appropriate feed-in tariff for promoting solar energy would be necessary.

## **3.0 Regulatory Framework for Tariff determination**

The Electricity Act, 2003 has radically changed the legal and regulatory framework for the renewable energy sector. It envisages, inter alia, *that* State Electricity Regulatory Commissions (SERCs) should take steps to promote renewable and non-conventional sources of energy.

The Electricity Act, 2003 and various policy documents such as the National Electricity Policy, Tariff Policy etc, provide for promotion and preferential treatment including tariff for renewable energy sources as well as stipulation of renewable power purchase obligation by SERCs.





specific recommendations to Regulators for solar power development in India made in this report are reproduced below:-

***Policy for Renewable and Non-Conventional Energy Sources [Chapter 7  
Para 3 of IEPR]***

***“Respective power regulators should mandate feed-in laws for renewable energy, where appropriate, as provided under the Electricity Act and as mandated in many countries. The following specific policies to promote various renewables are recommended. ....***

*Solar thermal power plants: The economic viability of solar thermal plants has not yet been fully established. To encourage entrepreneurs to invest in the technology, a higher premium on feed-in tariff may be given. The higher premium can be justified on grounds of the higher risk and may be made available only to the first 5000 MW of solar thermal plants.*

*Solar photovoltaic: Although the present cost is very high, since the ultimate potential is very large, incentive to commercialize and lower the cost may be provided through a higher feed-in tariff, again for the first 5000 MW of installed capacity”.*

**5.0 Policy Guidelines for Generation Based Incentive For Grid Interactive Solar Power Generation Plants**

The Ministry of New & Renewal Energy (MNRE), Government of India vide notifications No.32/61/2007-08/PVSE dt.24<sup>th</sup> January, 2008 and No.8/1/2007-08/ST of March, 2008 has issued policy guidelines for Generation Based Incentive (GBI) for grid interactive solar power generation plants and launched a demonstration programme to encourage grid quality power generation from megawatt size solar power plants.

Under this programme, registered companies as project developers would be eligible to set up solar power projects on Build, Own and Operate (BOO) basis. MNRE provides generation based incentive of up to Rs. 12 per kWh for Solar photovoltaic and Rs. 10 per kWh for the solar thermal power fed to the grid by the developers. This incentive is in



addition to the tariff announced by SERCs. Further, this incentive will be available for 10 years. A project developer would be eligible to receive a maximum of Rs. 15 per kWh including tariff and incentive for Solar PV based project and Rs.12 per kWh for Solar thermal based project. Any project that is commissioned after 31<sup>st</sup> December, 2009 would be eligible for a maximum incentive with a 5% reduction p.a. and ceiling of Rs. 11.40 per kWh for solar PV and Rs. 9.50 per kWh for solar thermal.

In case any project developer is desirous of availing the accelerated depreciation benefit for the project under section 32 of the Income Tax Act 1961, they would not be eligible for generation-based incentive.

The MNRE would provide the above mentioned incentive for installation of up to 50 MW capacity of solar power projects in the country subject to an aggregate capacity of a maximum 10 MW in a State which would be considered for support during the 11<sup>th</sup> Five Year plan period for the plants commissioned upto 31<sup>st</sup> December, 2009.

Under this demonstration project any developer would be allowed to set up a maximum aggregate capacity of 5 MW, either through a single project or multiple projects of a minimum capacity of 1 MW each. It is also mentioned that preference would be given to the projects from the States where the SERCs have announced or are in the process of announcing tariff for solar power.

It is also mentioned that wherever the SERC has not announced or is not in the process of announcing such tariff, the utility should provide the highest tariff offered for medium term power purchase or maximum tariff fixed for power from any other renewable sources, till the SERC announces a tariff for solar power, failing which projects in that state would not be considered under the demonstration programme. Accordingly, various SERCs came out with Tariff for Power Generation from solar energy.

## 6.0 Determination of Tariff for solar energy by SERCs.

Various SERCs have issued orders determining the tariff for solar energy projects which are as under:

Sr.No.	Name of ERC	Dt.of Order /Regulation	Rate of Tariff



1.	PERC	13.12.2007	Rs.7.00/kWh with five annual escalation @ 5% till FY 2011-12
2.	WBERC	25.3.2008	Rs.11.0 /kWh for Solar PV projects commissioned upto 2009-10 and thereafter for the projects which are commissioned between 2009-10 to 31.3.2012 the tariff shall be Rs.10 /kWh.
3.	RERC	2.4.2008	<p>1.Solar power plants commissioned upto 31.12.2009</p> <ul style="list-style-type: none"> <li>• <b>SPV Technology</b> Rs.15.78/kWh (Rs.3.78/kWh (wind tariff) + Rs.12/kWh incentive from GoI).</li> <li>• <b>CSP technology</b> Rs.13.78 /kWh (Rs.3.78/ kWh (wind tariff) + Rs.10 / kWh incentive from GoI).</li> </ul> <p>2. Solar power plants commissioned after 31.12.2009 but by 31.3.2010.</p> <ul style="list-style-type: none"> <li>• <b>SPV Technology</b> Rs.15.18/kWh</li> <li>• <b>CSP technology</b> Rs.13.18 /kWh</li> </ul>
4.	HERC		Rs.15.96/ kWh solar power plants commissioned upto 31.12.2009 and Rs.15.16 /kWh commissioned after 31.12.2009 but by 31.3.2010.

**Gujarat Electricity Regulatory Commission (GERC) Order on Solar Energy Tariff for demonstration projects under GOI guidelines:**

The Commission has determined Tariff for solar energy from the demonstration projects under the MNRE scheme by issuing an Order No.1 of 2009 dt.22<sup>nd</sup> January, 2009. In the said order, the Commission has determined Rs.3.37 per kWh as the procurement price by the Distribution Licensees for Solar energy. The project developer will be entitled to the Government incentives for the grid connected solar projects as laid down in the MNRE, GoI Policies on Solar Photovoltaic and Solar Thermal projects. Accordingly, the



project developers in Gujarat are eligible to get Rs.3.37 per kWh from the distribution licensees and upto Rs.11.63 per kWh for Solar Photovoltaic projects and Rs.8.63 per kWh for Solar thermal projects as incentive from GoI. It means, a project developer will get Rs. 15 per kWh in case of solar photo-voltaic and Rs. 12 per kWh in case of solar thermal, inclusive of the price to be paid by distribution licensee and incentive paid by Government of India.

## 7.0 Government of Gujarat (GoG) Solar Power Policy-2009

The Government of Gujarat, in order to promote grid connected solar energy generation, has come out with Solar Power Policy - 2009 under the Resolution No. SLR-11-2008-2176-B dtd. 7.1.2009. The operative period for the scheme is upto 31.03.2014. The relevant clauses relating to operative period, incentive scheme for wheeling, tariff, etc. are reproduced below:

- **Installed Capacity:** *A maximum of 500 MW of Solar Power Generation (SPG) capacity is proposed for installation during the operative period of the Policy.*
- **Capacity Cap:** *The minimum Project capacity of an SPG, in case of Solar Photovoltaic (SPV) and Solar Thermal (ST) shall be 5 MW each.*
- **Wheeling Charges:** *The wheeling of electricity generated from the SPGs, to the desired location/s for self-use within the State, shall be allowed at a wheeling charge of 2% of the energy fed to the grid, till the wheeling charge is determined by Gujarat Electricity Regulatory Commission (GERC) and thereafter at the wheeling charge as determined by GERC order(s), as amended from time to time.*
- **Exemption from payment of Electricity Duty:** *Electricity generated from the SPGs and used for self consumption / sale to third party / sale to licensees shall be exempted from payment of Electricity Duty.*
- **Sale of Energy:** *The energy generated from a Solar Power Project, shall be sold to the Distribution licensees in the state at levelised fixed tariff per KWh as mentioned below for the period of 25 years, under a Power Purchase agreement.*

Sr.No.	Particulars	Tariff for Photovoltaic (Rs./kWh)	Tariff for Thermal Projects (Rs./ kWh)
(i)	Projects commissioned	13.00 (for first 12 years) 3.00 (from 13 <sup>th</sup> to 25 <sup>th</sup> year)	10.00 (for first 12 years) 3.00 (from 13 <sup>th</sup> to 25 <sup>th</sup> year)



	before 31.12.2010		year)
(ii)	Other Projects commissioned before 31.03.2014.	12.00 (for first 12 years) 3.00 (from 13th to 25 <sup>th</sup> year)	9.00 (for first 12 years) 3.00 (from 13th to 25 <sup>th</sup> year)

- **Benefits of this policy will not be available to projects set up under the MNRE incentive scheme for Solar Power Generation.** Further, any subsidy/ incentive received by SPG developer from any source shall be reduced from above mentioned rate for purchase of power from SPG developers except the benefit of Accelerated Depreciation under Income Tax Act.
- **Security Deposit:** The Developer shall be required to provide Bank Guarantee @ Rs. 50 lacs per MW at the time of signing of Power Purchase Agreement with GUVNL and/ or Distribution licensee and in case the Developer fails to achieve Commercial Operation within the time period mentioned in Power Purchase Agreement, the Bank Guarantee shall be forfeited. The bank guarantee shall be refunded, if the developers achieve commercial operation within time period mentioned in Power Purchase Agreement.
- **Plant and Machinery:** Only new Plant and Machinery shall be eligible for installation under this Policy.
- **Metering of Electricity:** The electricity generated from the SPGs, shall be metered on a monthly basis jointly by Gujarat Energy Development Agency (GEDA)/ Gujarat Energy Transmission Company Limited (GETCO) at the sending sub-station of 66 kV or above, located at site. For the purpose of energy accounting Solar based generation projects will have to provide ABT compliant meters at the interface points. Interface metering shall conform to the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.
- **Grid Connectivity and Evacuation facility up to GETCO substation:** The evacuation facility from the Solar Substation/Switchyard to the GETCO substation shall be initially approved by GETCO after carrying out the system study. The power by the SPG shall be injected at 66 kV. The transmission line from the switchyard of the Solar Substation to the GETCO Substation shall be laid by GETCO. They should be integrated by installing RTUs by solar project





developer so that the penetration can be monitored at the connectivity substation by the SLDC on real time basis.

- **Open Access for third party Sale:** If Open Access is granted to any developer or beneficiary they shall have to pay the applicable Open Access charges and losses as approved by GERC from time to time. However, the Cross Subsidy Surcharge shall not be applicable for Open Access obtained for third party sale within the State.
- **Forecasting and Scheduling:** The SPG based generation shall not be covered under scheduling procedure for Intra State ABT. However, the actual energy injected in the grid during particular time block of 15 minutes shall be post-facto considered in drawl schedule for sale of power to licensee / Third party or for giving set-off against the consumption of recipient kWh in case of wheeling.
- **Reactive Power Charges:** The drawl of reactive power shall be charged as per the GERC order, as amended form time to time.
- **Sharing of Clean Development Mechanism (CDM) Benefit:**  
*The Solar Power Project Developer will pass on 50% of the gross benefits of CDM to the Distribution licensee with whom PPA is signed.*

## 8.0 Meeting on Grid Related issues of Wind and Solar based power generation.

The Commission had organized a brainstorming meeting on Grid connectivity and its related issues on Wind and Solar based power generation on 7<sup>th</sup> February, 2009 at Ahmedabad. In this meeting, experts from State Electricity Regulatory Commissions, Executive Director, National Load Dispatch Centre, senior officials of Ministry of New and Renewable Energy Sources, CEA, Govt. of India, senior officials of utilities, officials of Wind and Solar Associations, Consultants and WISE were present.

During the discussion, it was accepted by the participants that the power generated from wind and solar is mostly infirm and cannot be scheduled. In recent years, capacity of wind power generation has significantly increased. However, an issue regarding grid stability has been raised by the State Transmission Utility (STU) and others. This was discussed in detail during the meeting. Some of the experts expressed their opinion stating that there being a national grid of about 1 lakh MW, any such infirm generation by wind or solar cannot be a major threat to the grid stability.



Solar based generation is predictable to some extent and is more stable compared to wind energy generation. It was observed that the main issue for producing solar power from crystalline silicon technology is cost reduction by way of improvement in technology and large scale production. The major constraint is that India is not a major producer of silicon. Production of silicon can bring down the cost of solar power. Solar Radiation Mapping has two components: concentrated and non-concentrated radiation. Hence, both types of radiation are required to be mapped and necessary data base should be created for it. There is immense scope for reduction in cost of solar power generation with new technological advancement. Concentrated radiation is suitable only for photovoltaic cell.

It is essential to carry out necessary transmission planning for evacuation of such generation. It is also essential that grid connectivity should be provided in such a manner that it will not affect the generation of projects when they become ready. A former member of the CERC pointed out that renewable energy sources like wind and solar do not require any fossil fuel for generation of electricity and hence they help to create an environment-friendly atmosphere. Any grid stability issue could be resolved by creating necessary infrastructure and changes in the system, as it is being done in developed countries.

## **9.0 Some Issues before GERC**

9.1 The Commission has also received several letters and enquiries from various developers (interested to develop large solar power projects within the State beyond the 5 MW capacity limit) with regard to the applicable tariff for such grid connected solar power projects.

As mentioned earlier, Government of Gujarat came out with a Solar Power Policy-2009 wherein tariffs were indicated for solar photovoltaic and solar thermal projects. It was, however, mentioned that the GERC Regulations/Orders issued from time to time shall prevail.



Further, according to the Sections 61, 62 and 86(1)(e) of the EA, 2003, it is the Commission's jurisdiction to determine tariff for solar generation projects. Hence, the Commission considered it appropriate to initiate a regulatory process on a suo-motu basis for determination of Tariff for Solar power projects within the State.

9.2 Reliable data on benchmarking the cost per MW in respect of solar energy is not available at present. The project cost also depends on the solar technology and other related matters. The Govt. of India in its Policy had not specified the project cost and had worked out the tariff based on some assumption on the project cost which could be between Rs.15 to 20 crores per MW. As such, there is an issue regarding what should be the per MW project cost which should be considered for determining the tariff.

9.3 During discussion with the various prospective developers, an issue regarding level playing field has been posed before the Commission. This was mainly on the ground that a developer who brings foreign capital to India, or is a new entity, would not be entitled to the benefit of accelerated depreciation under the Income Tax Act, 1961. As such, their cost per kWh would be higher than that of the developer who would be getting the benefit of such depreciation.

9.4 During the meeting of experts on 7.2.2009, an issue regarding hybrid technology to be used in case of solar thermal projects was discussed at length. The State Government Policy does not make any mention of hybrid technology in solar energy projects. Solar Thermal projects could be much more viable with higher capacity and higher PLF if some fossil fuel is permitted to be used. The possibility of various combinations of renewables (solar + wind or solar + biomass or solar with limited fossil fuel) could be much more economical if undertaken as hybrid generation projects. Therefore, the issue of whether the Commission could allow hybrid approach in solar energy has also been raised before the Commission.

## **10.0 Commission's view on the Issues**

10.1 The GoG Policy allows the developers to take the benefit of accelerated depreciation under section 32 of the Income Tax Act, 1961 read with Rule 5 of the Income Tax Rules. Some potential investors have represented before the Commission



that this benefit is not relevant to those who bring in foreign capital, or being new entrepreneurs have no balance sheet. They have suggested that the tariff structure should provide a level playing field. A contrary argument has also been put forward saying that those who bring in foreign capital incur much lower interest cost compared to those who utilize domestic sources. In view of these aspects, it will be difficult to incorporate all the concerns of the stakeholders in the tariff. The Commission can fix a generalized tariff. Any developers who feel that he is at a disadvantage in respect of his project is free to file a petition before the commission, which will take a view after considering the relevant facts.

10.2 The GoG Policy has so far not allowed hybrid technology in the solar generation. However, such technology cannot be ruled out altogether. It is also important to note that there can be a range of hybrid technology with widely different cost structures. Hence, it may not be feasible to determine a generalised tariff for solar energy based on hybrid technology. The commission can look into a specific project if the prospective developer files a petition.

10.3 The issues regarding determination of solar power generation tariff and incentives are addressed in the following paragraphs.

## **11.0 Determination of Tariff by the Commission**

### **11.1 Technology and Project specific Solar Tariff**

There are multiple technological options such as solar photo-voltaic (using different materials such as thin film, poly-crystalline, amorphous, silicon etc.), and concentrated solar thermal (dish, parabolic, tower) available in the market. Each such technology has different efficiency and performance parameters. Moreover, project cost structure also differs significantly from one solar power project to another.

Considering the capital costs involved in the solar generation projects, it is expected that the project size could be small and the number of projects may be large with diverse technological options. Therefore, determination of project specific tariff for each solar generation project would involve significant regulatory cost and time to understand the technical nuances of the proposed projects and scheme/technology proposed to be



deployed by each project developer. It is significant to note that grid connected solar power project development is still at a nascent stage in India.

Under these circumstances, the Commission is of the view that differentiation in terms of technology for the purpose of tariff determination is not desirable. Selection of appropriate technology should be left to the discretion of solar project developers. Therefore, the Commission has adopted an approach of Generic Tariff determination.

### **11.2 Single Part and Levelised Tariff**

The tariff of a conventional power plant consists of two components: fixed cost and variable cost. The variable cost depends on the type of fuel utilized. Solar energy generation utilizes sunshine as a resource. It does not utilize any fuel for generation of electricity in case of solar PV generation. However, salt is used in case of solar thermal operation. Hence, the solar energy generation tariff does not have a fuel cost component. It has a significant fixed cost component. Thus, it is basically a single-part tariff. Solar energy generation depends on natural factors and it is infirm in nature. The level of actual generation depends on the availability of solar density in the area of the solar electricity generators. It is necessary to ensure a cash flow stream to the project developer, while at the same time protecting the interests of utility and consumers by avoiding huge cost burden on them. There are various approaches to determine the tariff, such as front loaded, back loaded, and average tariff etc. Each of these has its own merits and demerits. It is essential to reflect the time value of money in the tariff structure. Levelised tariff incorporates the time value of money. The Commission has, therefore, proposed to adopt a levelised tariff in the context of this order.

### **11.3 Components of Tariff**

While determining the Solar power Tariff, it is essential to adopt appropriate financial and operational parameters. In the context of a tariff determined on a cost-plus basis, it significantly depends on the following financial and operational parameters.



- (i) Capital cost
- (ii) Power Evacuation facility and its cost
- (iii) Operation & Maintenance charges
- (iv) Debt - Equity Ratio
- (v) Terms of Loan and Interest rate of loan
- (vi) Return on equity
- (vii) Depreciation
- (viii) Interest on Working Capital
- (ix) Capacity Utilization Factor
- (x) Duration of Tariff

The solar based power generation depends on the technology used by the project developer such as (i) Solar Photovoltaic and (ii) Solar Thermal. The financial and operational parameters considered by the Commission based on the above technologies are described in the following paragraphs.

### **11.3.1 Solar Photovoltaic (SPV) Projects**

#### **(i) Capital cost**

The capital cost of a Solar PV power project consists of cost of PV modules, balance of plant and power conditioning system costs, taxes and duties, inter-connection costs, civil works, erection and commissioning and service charges. There is no separate break-up of costs available for different items. The Rajasthan Electricity Regulatory Commission has estimated capital cost for Solar PV power generation in the range of Rs.17 Cr/MW to Rs.21 Cr/MW. The Karnataka Renewable Energy Development Agency has considered a capital cost varying from Rs.18 Cr/MW to Rs.25 Cr/MW. The CERC, in a recently published Explanatory Memorandum for Tariff Norms for Solar Power Projects, considers a normative capital cost of Rs.18 Cr/MW in case of grid connected solar PV based power projects for the first year of the control period which shall be reviewed by the Commission for the subsequent years during the control period. The Commission has received a petition from M/s. Astonfield Solar (Gujarat) Pvt.Ltd. in which the project developer has proposed a capital cost at Rs.17.55 Cr/MW.

It is important to note that with the advancement in the technology of the solar PV based installations, economies of scale and competition would ensure that the capital cost for Solar PV installations would decrease over time. The Commission has, after considering the above aspects, proposed a normative capital cost of Rs.17 Cr/MW



## **(ii) Evacuation Cost**

As per the provisions made in Sections 39(2) ( c) of the Electricity Act 2003, the State Transmission Utility (STU) has to ensure development of economical and efficient system of intra-state transmission to bring electricity up to load centres. Section 40 of the Electricity Act 2003 casts a duty on the STU to build, maintain and operate an efficient, coordinated and economic transmission system and provide non-discriminatory open access to user(s) on payment of necessary charges as specified by the State Electricity Regulatory Commission. Section 86(1) (e) also stipulates that the State Commission can take suitable measures for providing grid connectivity to the renewable energy sources. The Forum of Regulators has also recommended that Grid Connectivity be provided by the transmission and distribution licensees for renewable energy sources in an optimal manner. The power generated from the solar power projects is purchased by the distribution licensees. They need to purchase the power from the generator bus bar. It is the duty of the licensee to create necessary infrastructure for this aspect. Hence, evacuation cost is not considered by the Commission for the purpose of this order.

## **(iii) Operation & Maintenance Cost**

Operation and Maintenance (O&M) cost consists of spares, employee cost, administrative and general expenses, repairs and maintenance, and insurance expenses. There is limited operating experience of MW scale solar PV Grid -connected power plant in the State and in the country. Solar PV power plant's operation and maintenance is carried out through a centralized maintenance system which results in less employee expenses, administrative and general expenses. The Commission has considered O&M expenses (i) at the rate of 0.5% of the Capital Cost for the first year, (ii) the same to be increased @ 5% per annum and (iii) insurance cost at the rate of 0.50% of the net asset of the project during the year.

## **(iv) Debt Equity Ratio**

Clause 5.3(b) of the Tariff Policy (TP) notified by the Government of India stipulates a debt-equity ratio of 70:30 for financing of power projects. The terms and conditions of Tariff Regulation 2005 notified by the Commission also provide a normative debt-equity



ratio of 70:30 for Generating Company/Licensees. Moreover, when the equity employed is more than 30%, the amount of equity for the purpose for determining the tariff will be limited to 30% only. However, in case the equity employed is less than 30%, the actual equity employed is to be considered.

Accordingly, the Commission proposes a debt-equity ratio of 70:30 as per the existing practice which is in line with the Tariff Regulation, 2005.

#### **(v) Loan Tenure and Financing Charges**

The project developer may require term loan for creation of capital assets. The CERC has, in its Explanatory Memorandum for Draft Terms and Conditions for Determination of Tariff for Renewable Energy Sources published in May, 2009, specified a normative loan tenure of 12 years for long-term loan with one year moratorium, to ensure adequate yearly cash flow for RE Projects. Considering the above, the Commission proposes the tenure of term loan as twelve years with a moratorium of one year in equal installments for determination of the tariff.

#### **(vi) Interest Rate**

The Commission considered an interest rate of 10.25% in its wind tariff order dtd.11.8.2006 and the draft tariff order no.2 of 2009. Recently, the interest rates for both deposit and loans are being reduced by the financial institutions. The Commission also proposes to stipulate higher RPPO and as such, sale of electricity by the renewable sources would not have high risks. Therefore, the Commission do not find it necessary to increase the rate of interest for long-term loan. Therefore, the Commission proposes to consider a rate of interest of 10.25% for determination of tariff for solar energy generation.

#### **(vii) Return on Equity**

The Tariff Policy dt.6<sup>th</sup> January,2006 notified by the Government of India, Ministry of Power envisages that the appropriate Commission may determine preferential tariff for procurement of power by distribution licensee from non-conventional energy sources.





The CERC in its Explanatory Memorandum for Draft Terms and Conditions for Determination of Tariff for Renewable Energy Sources published in May, 2009 proposes preferential returns on equity at the rate of 17% p.a. for the initial 10 years and at the rate of 23% p.a. for the period beyond 10 years. The value base for the equity shall be 30% of the capital cost or lower in case the actual equity is less than 30% of the capital cost.

The Commission has notified Regulation on Terms and Conditions of Tariff in which the return on equity is allowed at 14% per annum. The commission has also considered Income Tax @ 11.33% (MAT) for the initial period of 10 years and thereafter a Corporate Tax at the rate of (33.99%) after commercial operation of both Solar PV and Solar Thermal based projects. Considering the relevant material available, the commission proposes the returns on equity at the rate of 14% per annum and reimbursement of Tax at the rate of 11.33% p.a.( of the return on equity) for the initial 10 years and at the rate of 33.99% p.a.( of the return on equity ) for the period beyond 10 years for determination of tariff.

#### **(viii) Rate of Depreciation**

The CERC in its Explanatory Memorandum for Draft Terms and Conditions for Determination of Tariff for Renewable Energy Sources published in May, 2009 proposes depreciation at the rate of 6% p.a. for the initial 12 years and that the remaining depreciation shall be spread over the remaining useful life of the project from the 13<sup>th</sup> year onwards.

The Commission has notified the Regulation on Terms and Conditions of Tariff, 2005 in which it is specified that depreciation rate should be calculated based on the straight line method as specified in the CERC Terms and Conditions of Tariff Regulation 2004, which lay down that asset life is to be depreciated up to 90% of its initial value (considering residual value of 10% of its initial value) over the entire asset life (which is 25 years). After considering all aspects the Commission proposes the rate of depreciation at the rate of 6% p.a. for the initial 12 years and the remaining depreciation shall be spread over the remaining useful life of the project from the 13<sup>th</sup> year onwards (which would be @ 1.385% ) for determination of tariff.



### **(ix) Interest on Working Capital**

The working capital requirement in respect of Solar PV Power projects may be computed by considering the following parameters:

1. Receivables equivalent to one month's energy charges for sale of electricity calculated on a normative CUF.
2. One month's cost on operation and maintenance expenses.

The Commission proposes an interest rate on working capital @ 12.5% per annum for the purpose of this tariff order.

### **(x) Capacity Utilization Factor (CUF)**

Capacity Utilization Factor (CUF) for a Solar Photovoltaic project is the ratio of actual energy generated by the SPV project over the year to the equivalent energy output at its rated capacity over the yearly period. The energy generation for an SPV project depends on solar radiation, measured in kWh/ sq m/day and number of clear sunny days. The output of Solar Cell is measured in terms of Wp (Watt Peak) and refers to nominal power under Standard Test Conditions (STC) (1000 W/m<sup>2</sup>, 250°C , 1.5AM). The capacity utilization factor depends on site specific parameters like insolation, ambient conditions, conversion efficiencies of PV cell etc. CERC in its Explanatory Memorandum for Tariff Norms for Solar Power Projects indicates that around 290 to 320 clear sunny days are prevalent across most parts of India throughout the year. They have considered an average number of clear sunny days of around 300 and daily average global solar radiation to be around 5.8 kWh/ Sq m/day. The Capacity Utilization Factors for various Solar PV based power projects vary from 15% to 25% based on SPV (thin film or crystalline) and up to 35% based on concentrated PV (CPV). The CERC has proposed a Normative CUF of 19% in case of grid connected Solar PV based Power projects. The Commission has received a petition from M/s.Astonfield Solar (Gujarat) Pvt.Ltd. in which they have proposed the gross CUF at 23.96% and after deducting module loss, transmission loss and inverter efficiency, proposed a net CUF at 18.18%. After considering the above aspects, the Commission proposes a CUF at 20% for tariff determination.

### **(xi) Duration of Tariff**



The Commission considered the life of a Solar PV power plant as 25 years and it is proposed that the tariff determined by this order be applicable for 25 years for the projects having Commercial Operation Date (COD) upto 31<sup>st</sup> December, 2011.

### **11.3.2 Solar Thermal**

#### **(i) Capital cost**

There is very limited experience in the field of electricity generation utilizing solar thermal technology in the country. The capital cost of a Solar Thermal power project based on deployment of parabolic trough technology or solar tower technology will vary from technology to technology. The capital cost of a solar thermal power plant consists of plant and machinery, civil works, commissioning work, evacuation facilities etc. There is no separate break-up of costs available for different items utilized in the solar thermal projects. The CERC in its explanatory Memorandum for Tariff Norms for Solar Power Projects indicates that the Rajasthan Electricity Regulatory Commission has invited public comments on the petitions filed by developers for determination of project specific tariff for Solar thermal power projects and it was found that the capital cost for Solar Thermal power generation is in the range of Rs.14.96 Cr/MW to Rs.39.35 Cr/MW. The Chhattisgarh State Electricity Regulatory Commission has proposed to consider a capital cost of Rs.17.5 Cr/ MW for Solar Thermal projects. Madhya Pradesh Electricity Regulatory Commission has proposed to consider Rs.13 Cr/MW and Rs.14 Cr/MW for projects utilizing Parabolic Trough and Solar Tower Technology. The CERC has in its Explanatory Memorandum for Tariff Norms for Solar Thermal Power Projects considered a normative capital cost of Rs.13 Cr/MW in case of grid connected solar thermal based power projects for the first year of the control period which shall be reviewed by the Commission for the subsequent years during the control period.

With advancement of the technology of the Solar Thermal installations, the economies of scale would ensure that the capital cost for Solar Thermal installations would decrease over time. The Commission has, after considering the above aspects, proposed a normative capital cost of Rs.13 Cr/MW

#### **(ii) Capacity Utilization Factor (CUF)**



CERC has in its Explanatory Memorandum for Tariff Norms for Solar Power Projects, stated that Capacity Utilization Factor (CUF) for a Solar Thermal project quoted by the developers in Rajasthan varies from 24% to 51% for Solar Thermal Power technologies. Various State Electricity Regulatory Commissions have considered the Plant Load Factor in the range of 22% to 24% while determining the tariff for Solar Thermal plants. The CERC has considered a normative capacity utilization factor of 25%. After considering the above facts, the Commission proposes the CUF at 25% for tariff determination.

### **(iii) Operation & Maintenance Cost**

There is no operating experience of MW scale solar thermal power plant till date in the State. It is observed that none of the State Electricity Regulatory Commissions has specified break up of operating expenses which comprise employee expenses, A&G expenses and operation and maintenance expenses. The CERC in its Explanatory Memorandum for Tariff Norms for Solar Thermal Power projects proposes a normative level of O&M expense of 1% of the capital cost with escalation at a rate of 5.72% per annum over the tariff period. The Commission, after considering the above aspects, proposes the normative O&M expenses at 1% of the capital cost with an escalation at the rate of 5% per annum for the determination of the tariff. The Commission has also considered insurance cost at the rate of 0.50% of the net asset of the project during the year.

### **(iv) Auxiliary Consumption Factor**

The auxiliary consumption for a solar thermal installation depends on configuration and mode of operation of the power plant. The auxiliary system includes the use of auxiliary heater to ensure that the salt used to store heat is maintained in a molten state during extended non-sunny days/ period. The CERC in its explanatory Memorandum for Tariff Norms for Solar Thermal Power projects proposes a normative auxiliary consumption factor of 10%. In the absence of specific details on this aspect, the Commission considered the auxiliary consumption factor as 10% for the determination of the tariff of Solar Thermal Power Project.



The remaining parameters for determination of Solar Thermal Power project tariff, i.e. (i) return on equity, (ii) Debt Equity Ratio (iii) depreciation, (iv) interest on working capital, (v) tenure of loan and rate of interest and (vi) duration of tariff (vii) insurance cost (viii) Evacuation cost are as per the Solar PV Power Projects.

#### 11.4 Tariff for solar PV and Solar Thermal Power projects

Based on the foregoing analysis, the various parameters considered by the Commission for determination of tariff are given in the table below:

Table 1

No	Parameter (per MW basis)	Proposed for Solar PV Power Project	Proposed for Solar Thermal Power Project
<b>Project Cost</b>		<b>(Rs in crore)</b>	<b>(Rs in crore)</b>
1	Capital cost	17	13
	<b>Total Capex</b>	<b>17</b>	<b>13</b>
<b>Operational parameters</b>			
2	Debt: Equity ratio	70:30	70:30
3	Cost of debt (tenure 12 years with one year of moratorium period)	10.25%	10.25%
4	Return on Equity	14% p.a	14% p.a
5	Tax on Return on Equity	11.33% for the initial 10 years and at the rate of 33.99% p.a. for the period thereafter.	11.33% for the initial 10 years and at the rate of 33.99% p.a. for the period thereafter.
6	O&M cost (% of the project cost)	0.5% of capital cost with escalation of 5% p.a.	1% of capital cost with escalation of 5% p.a.
7	Insurance (% of project cost)	0.5% of net assets during the year	0.5% of net assets during the year
8	Net CUF (at 100% grid & m/c availability)	20%	25%
9	Auxiliary consumption	Nil	10%
10	Actual machine availability	100%	100%
11	Actual grid availability	100%	100%
12	Project life (years)	25	25
13	Depreciation	6% for initial 12 years and thereafter 1.385% for 13 years.	6% for initial 12 years and thereafter 1.385% for 13 years.
14	Interest on Working Capital		
	(i) On one month's receivable	12.5%	12.5%
	(ii) One month's O&M cost		

Based on the various parameters as discussed above, the levelised tariff including RoE of Solar PV power generation, using a discounting rate of 10.19% as specified by CERC recently, works out to **Rs. 11.57 per kWh** and levelised tariff using the same discounting



factor for Solar Thermal Power generation works out to **Rs.8.38 per kWh**. However, the Commission feels that it would be appropriate to determine tariff for two sub-periods: 12 years and 13 years instead of the same tariff for 25 years. Hence, the Commission determines the tariff for generation of electricity from Solar PV Power project at **Rs.14.00 per kWh** for the initial 12 (twelve) years starting from the date of Commercial operation of the project and **Rs.4.00 per kWh** from the 13<sup>th</sup> (Thirteenth) year to 25<sup>th</sup> (twenty fifth) year. The Commission also determines the tariff for generation of electricity from Solar Thermal Power project at **Rs.10.00 per kWh** for the initial 12 (twelve) years starting from the date of Commercial operation of the project and **Rs.3.50 per kWh** from the starting date of the 13<sup>th</sup> (Thirteenth) year to 25<sup>th</sup> (twenty fifth) year.

The above tariff takes into account the benefit of accelerated depreciation under the Income Tax Act and Rules. For a project that does not get such benefit, the Commission would, on a petition in that respect, determine a separate tariff taking into account all the relevant facts.

This tariff rate shall be applicable for purchase of solar power generation by GUVNL/Distribution Licensees/ others for complying with the purchase obligation specified in the relevant Regulations of the Commission from time to time. This tariff will be applicable to solar power generators who will commission brand new solar energy plants and equipments during the control period upto 31<sup>st</sup> December, 2011.

## 12.0 General Issues

- **Plant and Machinery**

Only new Plants and Machinery shall be eligible for the benefit of tariff determined by this order.

- **Start up power/ Stand by supply**

The STU/Distribution Licensee shall provide start-up power for the solar generator under kWh to kWh adjustment basis.

- **Reactive Power Charges**

The Reactive Power Charges as approved by the Commission in its Tariff Orders from time to time shall be applicable to such projects.

- **Evacuation Facilities:**



- a. Interfacing line of appropriate capacity and voltage as per the CEA (Technical Standard for connectivity to the grid) Regulations, 2007 shall be provided by the STU/ Distribution Licensee at their cost. The intending generator shall apply to the STU/ Distribution Licensee concerned well in advance.
- b. The cost of switch gear, metering and protection arrangement at generator end shall have to be borne by the owner of solar generators.
- c. The grid interactive solar PV/ solar thermal plant may be connected to 66 KV grid line to minimize power transfer losses. However, the choice of grid voltage may be determined in consultation with the state utility concerned. While formulating the evacuation facilities, the provisions of the grid code and other regulations of the Commission in this regard will be followed by all concerned. The Project developer shall have to install Remote Transmitting Units (RTUs) so that the penetration can be monitored at the connectivity substation by the State Load Despatch Centre (SLDC) on real time basis.
- d. The evacuation facility from the Solar Substation/Switchyard to the Gujarat Energy Transmission Company (GETCO) substation shall be initially approved by GETCO after carrying out the system study.
- e. The transmission line from the switchyard of generator to the GETCO substation shall be laid by GETCO.

- **Transmission/ Wheeling Charges**

Whenever the power is sold to Distribution licensee, the generator will supply the power at the interconnection point of the STU near the generating station. Thereafter, the transmission charges will be borne by the distribution licensee.

The wheeling of electricity generated from the Solar Power Generators to the desired location/s for self-use (captive use) within the State shall be at a wheeling charges of 4% of the energy fed to the grid.



The Commission is of the view that Plant Load Factor in solar energy is significantly low compared to Conventional Sources. It is less than one-third of the conventional generators. Moreover, per unit price of solar generation is higher and as such for promoting third party sale from solar generation the Commission proposes that transmission/wheeling charges are at par with self use which is proposed at 4% of the energy fed to the grid.

- **Cross Subsidy Surcharge**

Third Party Sale under Open access transactions carried out using generation from solar power generation shall be exempted from levy of cross subsidy surcharge under section 42 (2) of the Electricity Act, 2003.

- **Security Deposit**

The developer shall be required to provide Bank Guarantee @ Rs.50 lacs per MW at the time of signing of PPA with the GUVNL and / or Distribution Licensee and in case the Developer fails to achieve Commercial operation within the time period mentioned in the Power Purchase Agreement, the Bank Guarantee shall be forfeited. The Bank guarantee shall be refunded, if the developer achieves commercial operation within the time period mentioned in the Power Purchase Agreement.

- **Applicability of Intra-State ABT**

The Intra-state ABT order should not be made applicable to solar power generation projects.

- **Energy Accounting**

The Commission has kept the solar based energy generation projects out of the purview of the Intra-State ABT. However, for the purpose of energy accounting, such projects will have to provide ABT compliant meters at the interface points. Interface metering shall conform to the Central Electricity Authority (Installation and Operation Meters) Regulations, 2006. The electricity generated from the Solar Power Generators shall be metered and readings should be taken jointly by the Gujarat Energy Development Agency





(GEDA)/ Gujarat Energy Transmission Company Ltd (GETCO) at the sending sub-station of 66 kV or above.

- **Power Purchase Agreement (PPA)**

The solar generator shall sign a PPA with the distribution licensee for a period of 25 years with a tariff as determined by this order. The distribution licensee shall sign the PPA at the earliest from the date of submission of the application with all relevant details by the solar generators and get it approved from the Commission.

### **13.0 Information for record-keeping**

The project developer shall maintain and provide technical information on daily solar radiation availability, hours of sunshine, duration of plant operation and the quantum of power fed to the grid. The project developer will install suitable instruments, meters and data loggers for this purpose. This information will be provided to GEDA as well as to the Commission from time to time. This will help in estimation of generation in kWh per MWp PV array capacity installed at the site.

### **14.0 Sharing of CDM**

The Govt. of Gujarat has in its Policy stated that the CDM benefit should be shared at 50% basis between the licensee and the project developer.

The Forum of Regulators constituted a Working Group for Renewable Energy Generation. The Group has recommended as under:-

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

The CERC has in its Explanatory Memorandum for Tariff Norms for Renewable Energy Projects recommended.



*“36. **Sharing of CDM Benefits.** The proceeds of carbon credit from approved CDM projects shall be shared in the following manner, namely-*

*(a) 100% of the gross proceeds on account of CDM to be retained by the project developer in the first year after the date of commercial operation of the generating station or the transmission system, as the case may be;*

*(b) in the second year, the share of the beneficiaries shall be 10% which shall be progressively increased by 10% every year till it reaches 50%, whereafter the proceeds shall be shared in equal proportion, by the generating company or the transmission licensee, as the case may be, and the beneficiaries.”*

Based on the above inputs, the Commission decides that CDM benefit to be shared by Developer in accordance with the methodology as proposed below:

(a) 100% of the gross proceeds on account of CDM to be retained by the project developer in the first year after the date of commercial operation of the generating station or the transmission system, as the case may be;

(b) in the second year, the share of the beneficiaries shall be 10% which shall be progressively increased by 10% every year till it reaches 50%, thereafter the proceeds shall be shared in equal proportion, by the generating company or the transmission licensee, as the case may be, and the beneficiaries.”

### **15.0 Applicability of Proposed Order**

This suo-motu Draft Order is issued to invite comments and suggestions from all the stakeholders including RE developers, Distribution Licensees, GUVNL, GEDA, etc. All stakeholders may submit their views, comments and suggestions on this within three weeks of the issuance of this Draft Order. The Commission shall finalize the Order after taking a view on the submissions received from the stakeholders on the draft Order.

**Place: Ahmedabad**  
**Date : 23.07.2009**

**Sd/-**  
**[P.S.SHAH]**  
**SECRETARY**

