

TAMIL NADU ELECTRICITY REGULATORY COMMISSION

Consultative Paper on “Comprehensive Tariff Order on Solar Power”

(Comments/Suggestions are invited on or before 15.03.2017)

1. Introduction

1.1 The importance of Solar Energy

1.1.1 Solar energy is a clean source of energy found in abundance. It is ecologically acceptable and helps combat the greenhouse effect caused by the use of fossil fuels. The country has a massive potential of solar energy resource. Tamil Nadu has reasonably high solar insolation of 5.5 to 6 kW/m² with around 300 clear sunny days in a year. With substantial solar insolation in the state, and an emerging market for solar energy at competitive rates, it is considered essential to utilize this major source of renewable energy.

1.2. Commission’s initiative in promoting renewable energy

1.2.1 To promote generation from renewable energy sources, the Commission has so far issued fifteen Tariff orders in respect of various renewable sources of energy in accordance with section 86(1)(e) of the Electricity Act, 2003. The Government of India through the Ministry of New and Renewable Energy launched the Jawaharlal Nehru National Solar Mission (JNNSM) in 2009 to promote the grid connected and off grid solar power generation. In pursuance of the above, the Commission, in order No. 1 and 2 dated 27/5/2010 & 8/7/2010 respectively, determined the tariff for Solar Photo Voltaic (PV) and Solar Thermal power under the Jawaharlal Nehru National Solar Mission .

1.3 Need for the Consultative paper

1.3.1 The Government of Tamil Nadu launched the Tamil Nadu Solar Energy Policy 2012 to promote solar energy. The Electricity Act, 2003, mandates the State Electricity Regulatory Commissions to promote generation of electricity from renewable sources of energy. In accordance with the provision of the Electricity Act, 2003, the Electricity policies issued by the Government of India and the Commission's Power Procurement from New and Renewable Sources of Energy Regulations, 2008, the Commission issued two tariff orders on Solar power viz. Order No.7 of 2014 dt.12.9.2014 and Order No.2 of 2016 dt.28.3.2016, for purchase of solar power by distribution licensees in the State and to deal with other related issues on the matter. The control period of the Order No.2 of 2016 dt.28.3.2016 is due to expire on 31.3.2017. The Commission has therefore evolved this consultative paper for issue of the tariff order on Solar power for purchase of solar power by distribution licensees in the State, for the next control period, duly inviting comments/suggestions from stakeholders.

2. Technology

2.1 Photovoltaics (PV) is the direct method of converting sunlight into electricity through a device known as the "Solar Cell". Many different solar cell technologies such as mono-crystalline and poly-crystalline silicon, thin films such as amorphous silicon, micromorph, cadmium telluride, copper indium gallium selenide and concentrator-based high-efficiency III-V, etc. are available in the market today. Further, substantial R&D efforts are also underway globally for

enhancing efficiencies, developing novel cell technologies that entail in reduction of costs of these solar cells.

2.2 Solar thermal technologies, also known as concentrated solar thermal (CST) technologies, typically concentrate on the direct component of sunlight to attain high temperatures and consequently generate electricity. The concentration is achieved typically through various reflection methodologies, which define these technologies. Parabolic trough, linear Fresnel, central receiver and parabolic dish are the primary solar thermal technologies. In addition to different types of construction of reflectors, these technologies also differ based on reliability, maturity, and economics.

2.3. Standards

2.3.1 Each of these technologies have different cost implications based on their efficiency, reliability, mounting, tracking, land, water and other requirements. The final selection of the technology shall be left to the Solar Power Developers. The minimum technical requirements would be as per the regulations/specifications issued by the Central Electricity Authority and Ministry of New and Renewable Energy and the developers shall adhere to them.

3. Legal provisions

3.1. Related Provisions of Electricity Act, 2003

3.1.1 Relevant provisions of Electricity Act, 2003 are reproduced below:

“Section 3(1): The Central Government shall, from time to time, prepare the National Electricity Policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilisation of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources

of energy.

Section 61: The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely:-

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- (h) the promotion of cogeneration and generation of electricity from renewable sources of energy;*
 - (i) the National Electricity Policy and tariff policy*

Section 62(1): The Appropriate Commission shall determine the tariff in accordance with the provisions of this Act for –

- (a) supply of electricity by a generating company to a distribution licensee:*

Section 62(2): The Appropriate Commission may require a licensee or a generating company to furnish separate details, as may be specified in respect of generation, transmission and distribution for determination of tariff.

Section 62(5): The Commission may require a licensee or a generating company to comply with such procedure as may be specified for calculating the expected revenues from the tariff and charges which he or it is permitted to recover.

Section 86(1)(e): The State Commission shall promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee;”

3.2. Related Provisions of National Electricity Policy

3.2.1 Relevant provisions of National Electricity Policy are reproduced below:

“Section 5.2.20 Feasible potential of non-conventional energy resources, mainly small hydro, wind and bio-mass would also need to be exploited fully to create additional power generation capacity. With a view to increase the overall share of non-conventional energy sources in the electricity mix, efforts will be made to encourage private sector participation through suitable promotional measures.

Section 5.12.2 The Electricity Act 2003 provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by providing suitable measures for connectivity with grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. Such percentage for purchase of power from non-conventional sources should be made applicable for the

tariffs to be determined by the SERCs at the earliest. Progressively the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the Commission may determine an appropriate differential in prices to promote these technologies.”

3.3. Related Provisions of Tariff Policy

3.3.1 Relevant provisions of Tariff Policy,2016 are reproduced below:

“Para 6.4 “(1) Pursuant to provisions of section 86(1)(e) of the Act, the Appropriate Commission shall fix a minimum percentage of the total consumption of electricity in the area of a distribution licensee for purchase of energy from renewable energy sources, taking into account availability of such resources and its impact on retail tariffs. Cost of purchase of renewable energy shall be taken into account while determining tariff by SERCs. Long term growth trajectory of Renewable Purchase Obligations (RPOs) will be prescribed by the Ministry of Power in consultation with MNRE.

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(i) Within the percentage so made applicable, to start with, the SERCs shall also reserve a minimum percentage for purchase of solar energy from the date of notification of this policy which shall be such that it reaches 8% of total consumption of energy, excluding Hydro power, by March 2022 or as notified by the Central Government from time to time.

.....

(iii) It is desirable that purchase of energy from renewable sources of energy takes place more or less in the same proportion in different States. To achieve this objective in the current scenario of large availability of such resources only in certain parts of the country, an appropriate mechanism such as Renewable Energy Certificate (REC) would need to be promoted. Through such a mechanism, the renewable energy based generation companies can sell the electricity to local distribution licensee at the rates for conventional power and can recover the balance cost by selling certificates to other distribution companies and obligated entities enabling the latter to meet their renewable power purchase obligations. The REC mechanism should also have a solar specific REC.

(iv) Appropriate Commission may also provide for a suitable regulatory framework for encouraging such other emerging renewable energy technologies by prescribing separate technology based REC multiplier(i.e granting higher or lower number of RECs to such emerging technologies for the same level of generation).Similarly, considering the change in prices of renewable energy technologies with passage of time, the Appropriate Commission may prescribe vintage based REC multiplier(i.e granting higher or lower number of RECs for the same level of generation based on year of commissioning of plant).

(2) States shall endeavor to procure power from renewable energy sources through competitive bidding to keep the tariff low, except from the waste to energy plants. Procurement of power by Distribution Licensee from renewable energy sources from projects above the notified capacity,

shall be done through competitive bidding process, from the date to be notified by the Central Government.

However, till such notification, any such procurement of power from renewable energy sources projects, may be done under Section 62 of the Electricity Act, 2003.”

3.4. Commission’s Regulations on Power Procurement from New and Renewable Sources

3.4.1 This consultative paper has been prepared in consonance with the provisions of Commission’s regulation on “Power Procurement from New and Renewable Sources of Energy Regulations, 2008” notified on 8.02.2008 and its subsequent amendments.

4. Power position in Tamil Nadu

4.1. The generating capacity in respect of conventional energy connected to the TANGEDCO’s grid including the allocation from Central Generating stations is 12618.98 MW as on 01.01.2017. This comprises of 4,320 MW from TANGEDCO’s thermal stations, 516.08 MW from gas turbine stations, 2307.9 MW from hydro stations and 5475 MW as Tamil Nadu’s share from central generating stations. Power from Independent Power Projects and Captive sources account for 746.5 MW and 986.5 MW respectively and another 3830 MW is through long term and medium term power purchases

4.2. Generating capacity from privately owned wind farms is 7678.16 MW. The installed capacity of cogeneration in sugar mills is 659.40 MW and biomass power projects is 230 MW. The installed capacity of solar power sources is 1546.75 MW which is inclusive of schemes under Jawaharlal Nehru National

Solar Mission(JNNSM), NTPC Vidyut Vyapar Nigam(NVVN) Bundling scheme and solar roof top schemes.

4.3. The peak demand in the State is around 15300 MW. The expected peak may vary from 16000 MW to 16200 MW. The peak power requirement is increasing at the rate of about 8% annually in the State.

5. Applicability of the proposed order

5.1 The Order proposed to be issued shall come into force from 01.04.2017. The tariff fixed in the order shall be applicable to all solar power plants commissioned during the control period of the Order. The tariff is applicable for purchase of solar power by Distribution Licensee from Solar Power Generators(SPGs). The open access charges and other terms and conditions specified shall be applicable to all the SPGs, irrespective of their date of commissioning.

6. Tariff Determination Process

6.1 With regard to tariff determination process, the relevant portion of Regulation 4 of the Power Procurement from New and Renewable Sources of Energy Regulations, 2008 is reproduced below:

“(1) The Commission shall follow the process mentioned below for the determination of tariff for the power from new and renewable sources based generators, namely;-

a) initiating the process of fixing the tariff either suo motu or on an application filed by the distribution licensee or by the generator.

b) inviting public response on the suo motu proceedings or on the application filed by the distribution licensee or by the generator.

d) issuing general/specific tariff order for purchase of power from new and renewable sources based generators.”

The Commission has prepared this consultative paper to elicit the views and suggestions of the stake holders.

7. Tariff / Pricing Methodology

7.1 Tariff / Pricing Methodology specified in Regulation 4 of the Power Procurement from New and Renewable Sources of Energy Regulations, 2008 is reproduced below:

“(2) While deciding the tariff for power purchase by distribution licensee from new and renewable sources based generators, the Commission shall, as far as possible, be guided by the principles and methodologies specified by:

- (a) Central Electricity Regulatory Commission*
- (b) National Electricity Policy*
- (c) Tariff Policy issued by the Government of India*
- (d) Rural Electrification Policy*
- (e) Forum of Regulators (FOR)*
- (f) Central and State Governments*

(3) The Commission shall, by a general or specific order, determine the tariff for the purchase of power from each kind of new and renewable sources based generators by the distribution licensee. In case of small hydro projects with a capacity of more than 5 MW but not exceeding 25 MW capacities, Commission decide the tariff on case to case basis.

Provided where the tariff has been determined by following transparent process of bidding in accordance with the guidelines issued by the Central Government, as provided under section 63 of the Act, the Commission shall adopt such tariff.

(4) While determining the tariff, the Commission may, to the extent possible consider to permit an allowance / disincentive based on technology, fuel, market risk, environmental benefits and social impact etc., of each type of new and renewable source.

(5) While determining the tariff, the Commission shall adopt appropriate financial and operational parameters.

(6) While determining the tariff the Commission may adopt appropriate tariff methodology.”

7.2. Project specific or Generalized Tariff

7.2.1 A generalized tariff mechanism would provide incentive to the investors for use of most efficient equipment to maximize returns and for selecting the suitable site while a project-specific tariff would provide each investor, irrespective of the machine type, the stipulated return on equity which, in effect, would shield the investor from the uncertainties involved. The order proposed to be issued is to mainly provide for power purchase by distribution licensees to meet their Renewable Purchase Obligation as specified in the Commission's Regulations. The solar power plants commissioned in the state have mostly adopted similar technology with minor modifications. Hence, the Commission proposes to issue a generalized tariff order for Solar Photovoltaic and Solar Thermal projects.

7.3. Single Part vs. Two Part Tariff

7.3.1. Two part tariff is generally adopted when the variable component is significant. In the case of solar energy generation, no variable cost like fuel cost is involved. Operation, maintenance and insurance cost could be taken care of by adopting suitable parameters. Therefore, the Commission proposes to continue with the single-part tariff for solar energy generation.

7.4. Cost-Plus Tariff Determination

7.4.1 Regulation 4(6) of "Power Procurement from New and Renewable Sources of Energy Regulations, 2008" empowers the Commission to adopt "appropriate tariff methodology" to determine the tariff for solar power. Cost-plus tariff determination is a more practical method. It can be easily designed to provide

adequate returns to the investor and a surety of returns will lead to larger investment in solar power plants. Commission in the last two tariff orders issued for solar power adopted cost plus single part levelled tariff taking into account the Accelerated Depreciation(AD) benefit as done by CERC and many other SERCs. The Commission proposes to adopt the same for this order on solar power.

8. Tariff Components

8.1 The Commission has carried out a detailed analysis of the existing policies/procedures and commercial mechanisms in respect of power generation from Solar based power plants. The tariff determined in a cost plus scenario, would depend significantly on the following operating and financial parameters:

1. Capital Cost
2. Capacity Utilisation Factor
3. Operation and Maintenance expenses
4. Insurance cost
5. Debt – Equity ratio
6. Term of Loan and Interest
7. Discount factor
8. Life of plant and machinery
9. Interest on Working Capital
10. Return on Equity
11. Depreciation

12. Auxiliary consumption

8.2 Capital Cost

8.2.1 The capital cost is one of the most important parameters for Solar Photovoltaic/ Solar Thermal power projects for tariff determination. The cost of the equipments involved is an important factor in determination of overall cost of the plants. The main components of a photovoltaic power plant are the photo voltaic modules, inverters, module mounting structures, cables, control panels, switchyard etc. Apart from the above, erection of power plant involves cost of land, civil works and evacuation infrastructure.

8.2.2 In the last one year, the country has witnessed aggressive biddings for grid connected solar Photo Voltaic (PV) power plants, that has brought down the per unit cost of solar power to a much lower range of Rs.4.34 to Rs.4.43. The e-reverse auction conducted by Solar Energy Corporation of India under the Domestic Content requirement category in the month of December 2016 has fetched a price of Rs.4.43 per unit though this has viability gap funding.

8.2.3 The distribution licensee, TANGEDCO has proceeded with reverse bidding in the month of October 2016 and had obtained a bid price of Rs.4.50 per unit quoted by two bidders for a capacity of 10 MW each, with the plant's expected commissioning date 13 months from the date of tender. The rates being competitive, the licensee has resorted to reverse bidding for the second time at a ceiling price of Rs.4.50.

8.2.4 The utility has managed to obtain the best prices through reverse bidding but has not been able to obtain the desired capacity.

8.2.5 The Commission has therefore decided to proceed with the cost plus determination of tariff for solar power considering the trend of module prices and the latest prices of other components in the market at nominal interest rates, that would serve as a benchmark price for the state's utility.

8.2.6 The pricing trend in the Photo Voltaic industry indicates a decline of about 14% in the cost of PV modules over the past one year. With advancements in technology, higher capacity utilization factors have been reported. The decline in cost of inverter coupled with technological advancements and higher efficiency will further reduce capital costs.

8.2.7 The capital cost considered by the Central commission and a few other state electricity regulatory commissions in the last of the tariff orders on solar power issued by them are tabulated herein. CERC in the draft Terms and Conditions for determination of tariff for Renewable Energy Sources issued on 16th February 2017 has not specified capital cost for Solar PV and Solar Thermal power projects.

Sl. No	Agencies	Reference	Capital cost	
			Solar PV Rs. Crores/MW	Solar Thermal Rs. Crores/MW
1.	CERC	Order dt.29.4.2016	5.302	12.00
2.	GERC	Order dt.17.08.2015	6.15	12.00
3.	RERC	Order dated 23.8.2016	5.1859	11.823
4.	MERC	Order dt.29.4.2016	5.302	12.00

8.2.8. The Commission observes that the prices of modules with high efficiency have shown significant reduction. Therefore, the Commission proposes a capital cost of Rs.4.70 crores per MW in respect of Solar Photovoltaic power projects. In the case of solar thermal, the decline in capital cost is less due to its conventional constituent of the capital equipments. The Commission proposes to adopt a Capital Cost of 11.6 Crores per MW for Solar Thermal projects. The Capital cost as proposed is inclusive of all capital works i.e plant and machinery, auxiliaries, costs towards changing inverter during the life-time, land, civil work, erection and commissioning, financing and interest during construction, and evacuation infrastructure. The capital cost fixed for solar PV is inclusive of cost of module degradation. It is upto the developer to identify the appropriate land based on solar insolation and cost.

8.3 Capacity Utilisation factor

8.3.1 The Capacity Utilisation Factor (CUF) adopted by different entities are tabulated below:

Sl. No	Agencies	Reference	Capacity Utilisation factor	
			Solar PV	Solar Thermal
1.	CERC	Order dt.29.4.2016	19%	23%
2.	GERC	Order dt.17.08.2015	19%	23%
3.	RERC	Order dated 23.8.2016	20%	23%
4.	MERC	Order dt.29.4.2016	19%	23%

8.3.2 The solar power plants installed under the NVVN scheme have recorded a CUF of 19 to 20%. The CUF considered in the earlier tariff orders on Solar power issued by the Commission was 19% for Solar PV power plant and 23% for Solar Thermal power plant. The Commission proposes to adopt the same in this order also. The normative CUF proposed in this paper is taking into account the deration of output.

8.4 Operation and Maintenance expenses

8.4.1 CERC by an amendment issued to the Terms and Conditions for determination of tariff from Renewable Energy Sources Regulations 2012 had fixed the operation and maintenance expenses at Rs.7 lakhs per MW for the year 2016-17 after having fixed it at Rs.11 lakhs per MW in the year 2012. The O&M cost adopted by other Commissions inclusive of CERC are tabulated below:

Sl. No	Agencies	Reference	Operation and maintenance in Rs. Lakhs/MW	
			Solar PV	Solar Thermal
1.	CERC	Order dt.29.04.2016	7; escalation at 5.72% p.a	18.74; escalation at 5.72% p.a
2.	GERC	Order dt.17.08.2015	10.9; escalation at 5.72% p.a	18 (1.5% of capital cost); escalation at 5.72% p.a
3.	RERC	Order dt.23.08.2016	7; escalation at 5.85% p.a	18.79; escalation at 5.85% p.a
4.	MERC	Order dt.29.04.2016	13.38; escalation at 2.96% p.a	15.44; escalation at 2.96% p.a

8.4.2. The Commission in its last two orders on Solar Power, adopted O&M expense of 1.4% of capital cost of solar projects with an escalation of 5.72% from the second year. The Commission proposes to adopt the same.

8.5 Insurance cost

8.5.1 In the two tariff orders for Solar power issued by the Commission, 0.35% of net asset value as insurance cost was adopted by the Commission. The Commission proposes to adopt the same in the next order.

8.6. Debt-equity ratio

8.6.1. The Tariff Policy lays down a debt equity ratio of 70: 30 for power projects. The Commission has proposed to adopt this ratio as specified in its Tariff Regulations 2005 and the earlier Orders on new and renewable power.

8.7. Term of the Loan

8.7.1 The term of loan adopted by different entities are tabulated below:

Sl. No	Agencies	Reference	Term of loan	
			Solar PV	Solar Thermal
1.	CERC	Order dt.29.04.2016	12 years	12 years
2.	GERC	Order dt.17.08.2015	10 years	10 years
3.	RERC	Order dt.23.08.2016	12 years	12 years
4.	MERC	Order dt.29.04.2016	12 years	12 years

8.7.2 The Commission proposes to adopt a term of 10 years with 1 year moratorium as adopted by the Commission in its previous orders on Wind, Bagasse, Bio-mass power and Solar.

8.8. Rate of Interest

8.8.1 The CERC, MERC, RERC have adopted the normative interest rate as average State Bank of India (SBI) Base rate prevalent during the first six months of the previous year plus 300 basis points. The rates of interest mentioned in the website of IREDA for grid connected Solar PV ranges from 10.20% to 11.40% and that for Solar Thermal ranges from 10.6% to 11.9%. The rates of interest adopted by various entities are tabulated below:

Sl. No	Agencies	Reference	Rate of interest	
			Solar PV	Solar Thermal
1.	CERC	Order dt.29.04.2016	12.76%	12.76%
2.	GERC	Order dt.17.08.2015	12.7%	12.7%
3.	RERC	Order dt.23.08.2016	12.76%	12.76%
4.	MERC	Order dt.29.04.2016	12.54%	12.54%

8.8.2. The prevalent lending rate being the marginal cost of funds based lending rate at which the bank prices all its loans, Commission proposes to adopt the latest MCLR rate of 1 year of 8% notified by the State Bank of India in February, 2017 plus 300 points which is 11 %.

8.9 Discount factor

8.9.1 The Commission proposes to adopt a discount factor equal to the post tax weighted average cost of the capital on the basis of normative debt: equity ratio (70:30) for the purpose of levellised tariff computation.

8.10. Life of Plant and machinery

8.10.1 The Commission proposes a life period of 25 years for Solar power projects as adopted by CERC, GERC, RERC and MERC.

8.11. Interest on Working Capital

8.11.1 In the Order on Renewables by the CERC, the components of working capital have been taken as O&M expenses for one month, receivables for two months and maintenance of spares at 15% of the O&M expenses. The Interest on Working Capital was fixed at interest rate equivalent to the average State Bank of India Base Rate prevalent during the first six months of the previous year plus 350 basis points. The interest rates adopted by various entities are tabulated below:

Sl. No	Agencies	Reference	Rate of interest	
			Solar PV	Solar Thermal
1.	CERC	Order dt.29.04.2016	13.26%	13.26%
2.	GERC	Order dt.17.08.2015	11.85%	11.85%
3.	RERC	Order dated 23.08.2016	12.26%	12.26%
4.	MERC	Order dt.29.04.2016	13.04%	13.04%

8.11.2. It is proposed to consider one month Operation and Maintenance cost and two months receivables as working capital components and an interest rate of 11.50%.

8.12. Return on Equity

8.12.1. The CERC has adopted normative Return on Equity (RoE) as 20% per annum for the first 10 years and 24% per annum 11th year onwards. The GERC has fixed RoE at 14% considering MAT for first 10 years and Corporate tax rate from the 11th year. MERC has considered RoE for first 10 years at 20.34% and from 11th year at 24.47%. The Tariff Regulations of the Commission stipulate 14% post tax RoE for conventional fuel based generating stations. With the objective of promoting renewable energy, Commission in its new and renewable energy Tariff Orders issued during 2009 considered 19.85% pre-tax return on equity, wherein the RoE was adopted linking it to MAT and IT. Since these factors are changing frequently, the Commission in its NCES orders issued in 2012, adopted a RoE of 19.85% without linking to MAT and IT and RoE of 20% (pre-tax) in the

last tariff order for solar power. The Commission now proposes to adopt a RoE of 20% (pre-tax) per annum for SPG without linking it to MAT and IT.

8.13. Depreciation

8.13.1. The CERC has adopted the normative depreciation rate of 5.83 % per annum for initial period of 12 years i.e. equivalent to the loan tenure and the remaining depreciation to be spread over the remaining useful life of the project from the 13th year. GERC has considered a depreciation rate of 6% annually for the first 10 years and 2% for the remaining 15 years. MERC has considered a depreciation rate as adopted by CERC. RERC has adopted a depreciation rate of 5.83% for the first 12 years and a rate of 1.54% for the period after the first 12 years. The Commission in its Orders on Wind, Bio-mass and Bagasse based energy issued during the year 2012 has depreciated the value of plant and machinery to 90% of the initial value for the life period using the straight line method which translates to 3.6% per annum. The same method was adopted in the tariff orders issued for solar power. Depreciation was calculated on 95% of the capital investment in the two orders on solar power. The Commission proposes to adopt the same method for the life period of 25 years

8.14. Auxiliary consumption

8.14.1 CERC has not considered auxiliary consumption for Solar PV plants but has considered auxiliary consumption of 10% for Solar thermal power projects. GERC has fixed the auxiliary consumption of 0.25% of energy generation in

respect of Solar PV plants and 10% in respect of Solar Thermal projects. MERC has also not considered auxiliary consumption for Solar PV plants but has considered auxiliary consumption of 10% for Solar thermal plants. RERC has not considered auxiliary consumption for Solar Photovoltaic, but has accounted 6.5% towards auxiliary consumption for Solar Thermal projects. Auxiliary consumption is considered to be negligible in the case of solar PV generators and therefore the Commission considers nil auxiliary consumption for PV generators. However, an AUX of 10% is proposed for the Solar Thermal projects considering the auxiliaries involved in such projects.

8.15. Tariff Determinants

8.15.1 The financial and operational parameters in respect of Solar Photovoltaic and Solar Thermal projects proposed in the paper are tabulated below:

Tariff Components	Solar PV	Solar Thermal
Capital Cost	Rs.4.70 Crores per MW	Rs.11.6 Crores per MW
CUF	19%	23%
Operation and Maintenance expenses	1.4% of Capital cost with escalation at 5.72% p.a from second year	1.4% of Capital cost with escalation at 5.72% p.a from second year
Insurance cost	0.35% of net asset value	0.35% of net asset value
Debt-equity ratio	70:30	70:30
Term of loan	10 years + 1 year Moratorium	10 years + 1 year Moratorium
Interest on Loan	11%	11%
Working capital components	One month O&M cost and Two months Receivables	One month O&M cost and Two months Receivables
Interest on	11.5%	11.5%

Working capital		
Return on Equity	20% pre tax	20% pre tax
Depreciation	3.6% on 95% of Capital cost	3.6% on 95% of Capital cost
Auxiliary consumption	Nil	10%
Discount rate	9.24%	9.24%
Levellised Tariff without AD	Rs.4.50 per unit	Rs.10.19 per unit
Levellised Tariff with AD	Rs.4.41 per unit	Rs. 9.98 per unit

9. Solar Power Tariff

9.1. Solar power tariff is computed with reference to the determinants listed above. The tariff works out to Rs. 4.50 per unit for Solar PV projects and Rs.10.19 per unit for Solar Thermal projects without Accelerated Depreciation(AD). The tariff rates of other SERCs and that of CERC are tabulated below:

Sl. No	Agencies	Reference	Tariff in Rs. per unit			
			Solar PV		Solar Thermal	
			Without AD	With AD	Without AD	With AD
1.	CERC	Order dt.29.04.2016	5.68	5.08	12.07	10.82
2.	GERC	Order dt.17.08.2015	5.86	5.34	11.22	10.11
3.	RERC	Order dated 23.08.2016	5.40	4.85	11.49	10.34
4.	MERC	Order dt.29.04.2016	6.04	5.41	11.47	10.17

10. Other issues related to power purchase by distribution licensee from SPGs.

1. Quantum of power purchase by the Distribution licensee
2. Plant capacity limitations
3. CDM benefits
4. Billing and Payments
5. Energy Purchase Agreement
6. Tariff Review Period / Control Period

10.1 Quantum of power purchase by the distribution licensee

10.1.1 The distribution licensee can purchase solar power at the rate determined by the Commission from SPG to meet the RPO requirement on “first come first served basis”. It is open to the Distribution licensee to procure the same through competitive bidding route following the guidelines of Government of India if it can realize a more competitive rate than the one determined by Commission’s order. For any procurement in excess of RPO, specific approval shall be obtained from the Commission.

10.2 Plant Capacity limitations

10.2.1 The Commission in the last tariff order for solar power had limited the purchase by the distribution licensee from solar power plants of 1MW capacity and above. The Commission proposes to adopt the same in this order also.

10.3 CDM Benefits

10.3.1 In the earlier orders issued on renewable energy, the Commission adopted the following formula for sharing of CDM benefits as suggested by the Forum of Regulators (FOR).

“The 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.”

10.3.2 The Commission proposes to adopt the same formula in this order also. The distribution licensee shall account for the CDM receipts in the next ARR filing.

10.4 Billing and payment

10.4.1 When a solar generator sells power to the distribution licensee, the generator shall raise the bill every month for the net energy sold after deducting the charges for power drawn from distribution licensee, reactive power charges etc. The distribution licensee shall make payment to the generator within 60 days of receipt of the bill. Any delayed payment beyond 60 days is liable for interest at the rate of 1% per month.

10.5 Energy Purchase Agreement (EPA)

10.5.1 The format for Energy Purchase Agreement (EPA) shall be evolved as specified in the Commission’s regulation on Power Procurement from New and Renewable Sources of Energy Regulations, 2008 and as amended from time to time. The agreement shall be valid for 25 years. The distribution licensee shall

execute the Energy Purchase Agreement or convey its decision in line with this order within a month of receipt of the proposal from the generator for selling power. The agreement fees are governed by the Commission's Fees and fines regulation.

10.6 Control period / Tariff Review Period.

10.6.1 Regulation 6 of the Power Procurement from New and Renewable Sources of Energy Regulations, 2008 of the Commission specifies,

“The tariff as determined by the Commission shall remain in force for such period as specified by the Commission in such tariff orders and the control period may ordinarily be two years.”

10.6.2 As the Capital cost continues to be volatile and not yet stabilized, in respect of Solar Power Plants, the Commission proposes to keep the control period as one year from the date of coming into force of this order, and the tariff period shall be 25 years.

11. Issues related to open access

1. Open access charges and Line losses
2. Cross subsidy surcharge
3. Reactive power charges
4. Grid availability charges
5. Energy Accounting and Billing Procedure
6. Energy wheeling agreement and fees
7. Security Deposit

8. Power factor disincentive
9. Metering
10. Connectivity and evacuation of power
11. Harmonics
12. Parallel Operation charges

11.1. Open access charges and line losses

11.1.1 Transmission, Wheeling and Scheduling & System Operation charges are generally regulated by the Commission's Tariff regulations, Open access regulations and Commission's order on open access charges issued from time to time. However, as a promotional measure, under section 86(1) (e) of the Act, the Commission proposes to adopt 30% in each of the transmission, wheeling and scheduling and system operation charges as applicable to the conventional power to the Solar power. Apart from these charges, the SPGs shall have to bear the actual line losses in kind as specified in the respective orders of the Commission and as amended from time to time. In respect of the plants availing Renewable Energy Certificates (REC), 100% of the respective charges as specified in the relevant orders shall apply.

11.2. Cross subsidy surcharge

11.2.1 The Commission in its other tariff orders related to different renewable power and in the orders for solar power, has ordered to levy 50% of the cross subsidy surcharge for third party open access consumers. Commission proposes to adopt the same for Solar power generators.

11.3. Reactive Power Charges

11.3.1 Commission proposes to adopt the reactive power charges as specified in its Order on Open Access charges issued from time to time.

11.4. Grid Availability Charges

11.4.1 Charges for the start-up power supplied by the distribution licensee

11.4.1.1 The question of start up power does not arise for Solar PV generators. However, the solar PV generator may require power for maintenance of power station especially during night hours. In case of Solar Thermal generators, the start-up may be frequent. Therefore, the drawal of such energy by the Solar Power Generator from the distribution licensee shall be adjusted against the generated energy for every billing period. This is applicable both for the SPGs selling power to the distribution licensee and for open access consumers. This is also applicable for the existing SPGs.

11.4.2. Stand by charges

11.4.2.1 If the drawal by the captive user or third party buyer exceeds generation, the energy charges and demand charges shall be regulated as per the Commission's Open Access regulation and Commission's Order on ABT and other relevant orders.

11.5. Energy Accounting and Billing Procedure

11.5.1 The energy accounting shall be regulated by the Commission's Regulations on open access, Order on open access and Order on ABT. Till such time the ABT is implemented in the State, if a solar power generator utilizes power for captive use or if he sells it to a third party, the distribution licensee shall raise the bill at the end of the billing period for the net energy supplied. The licensee shall record the slot wise generation and consumption during the billing period. Slot wise adjustment shall be for the billing period. Peak hour generation can be adjusted to normal hour or off peak hour consumption of the billing period and normal hour generation can be adjusted to off peak hour consumption of the billing period. Excess consumption will be charged at the tariff applicable to the consumer subject to the terms and conditions of supply. After the billing period, the balance energy may be sold at the rate of 75% of the respective solar tariff fixed by the Commission in the respective orders to the generators.

11.6. Energy Wheeling Agreement and fees

11.6.1 The format for Energy Wheeling Agreement, application and agreement fees, procedure and terms & conditions shall be governed by Commission's following regulations in force and as amended from time to time:

1. Tamil Nadu Electricity Regulatory Commission's Grid Connectivity and Intra State Open Access Regulations, 2014
2. Power Procurement from New and Renewable Sources of Energy Regulations, 2008.

11.7 Security deposit

11.7.1 As regards the security deposit to be paid by captive /third party user, the Commission proposes to retain the present arrangements i.e., charges corresponding to two times the maximum net energy supplied by the distribution licensee in any month in the preceding financial year shall be taken as the basis for the payment of security deposit.

11.8. Power Factor disincentive

12.8.1 Power factor disincentive may be regulated for the power factor recorded in the meter at the user end as specified in the relevant regulations/orders in force.

11.9. Metering

11.9.1 The Commission proposes that metering and communication shall be in accordance with the following regulations in force and any specific orders of the Commission on metering and ABT whenever issued:

- (1) Central Electricity Authority (Installation and Operation of Meters) Regulations 2006 and as amended from time to time.
- (2) Tamil Nadu Electricity Distribution and Supply Codes
- (3) Tamil Nadu Electricity Grid Code
- (4) Tamil Nadu Electricity Regulatory Commission's Grid Connectivity and Intra State Open Access Regulations, 2014

11.10. Connectivity and Evacuation of power

11.10.1 The provisions contained in Central Electricity Authority(Technical Standards for Connectivity to the Grid) Regulations,2007 and Central Electricity Authority (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations,2013, and its amendments shall be complied with. The connectivity and power evacuation system shall be provided as per the Act/ Codes/ Regulations/orders in force.

11.11. Harmonics

11.11.1 The SPGs shall follow the CEA (Technical Standards for Connectivity of the Distributed Generation Resources) Regulations, 2013 in respect of harmonics. It is the responsibility of the generator to provide adequate filtering mechanism to limit the harmonics within the stipulated norms. It shall be done before connecting the generator to the grid and the harmonics shall be measured by the respective distribution licensee during the commissioning. If the SPGs inject the harmonics beyond the stipulated limit, they shall pay a compensation of 15% of applicable generation tariff rate to the distribution licensee in whose area the plant is located till such time it is reduced within the stipulated limit. The distribution licensee is responsible for measurement of harmonics with standard meters and issue notices for payment of compensation charges if the harmonics is beyond the stipulated limit. A minimum of 15 days notice period shall be given for payment of compensation charges.

11.12 Parallel operation charges

11.12.1 SPGs who consume power for their captive loads but wish to avail REC may opt for paralleling their generators with the grid without wheeling power. Such generators shall pay 30% of applicable parallel operation charges to the distribution licensee as specified in relevant regulations.

(By order of Tamil Nadu Electricity Regulatory Commission)

(S.Chinnarajalu)
Secretary
Tamil Nadu Electricity Regulatory Commission

