TAMIL NADU ELECTRICITY REGULATORY COMMISSION

Comprehensive Tariff Order on SOLAR POWER

Order No 2 of 2016 dated 28- 03-2016

BEFORE THE TAMIL NADU ELECTRICITY REGULATORY COMMISSION

PRESENT: **Thiru S. Akshaya Kumar - Chairman**
Thiru G. Rajagopal - Member
Dr.T.Prabhakara Rao - Member

Order No. 2 /2016, dated 28-03-2016

In the matter of : Comprehensive Tariff Order on Solar Power

In exercise of the powers conferred by Sections 181, 61 (h), 62 and 86 (1) (e) of the Electricity Act 2003, (Act 36 of 2003), read with the National Electricity Policy, the Tariff Policy and Commission's Power Procurement from New and Renewable Energy Sources Regulations, 2008, the Commission, after issuing a consultative paper for public view on "Comprehensive Tariff Order on Solar Power" inviting comments from stakeholders and after examining the comments of all stakeholders, after consulting the State Advisory Committee (SAC) on 17/3/2016 and on consideration of the views of the stakeholders and the views expressed by the members of the SAC, passes this suo motu Comprehensive Tariff Order on Solar Power.

This order shall take effect on and from the 1st of April, 2016.

Sd./-	Sd./-	Sd./-
(T.Prabhakara Rao)	(G.Rajagopal)	(S.Akshaya Kumar)
Member	Member	Chairman

(By Order of the Commission)

Sd/-
(S.Chinnarajalu)
Secretary

CONTENTS

TAMIL NADU ELECTRICITY REGULATORY COMMISSION

"Comprehensive Tariff Order on Solar Power"

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/m^2 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 eleven 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 connected 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 (JNNSM).

1.3 Need for the Order

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 Government of India (GoI) and the Commission's Power Procurement from New and Renewable Sources of Energy Regulations,2008, the Commission issued a "Comprehensive tariff order on solar power" on 12.9.2014, 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 said order was for one year which was further extended until 31.3.2016 by Commission's order dt.1.4.2015. The Commission issues this "Comprehensive tariff order on solar power" for the next control period for purchase of solar power by distribution licensee from the solar power generators and to deal with other related issues.

2. Technology

2.1.1 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 further entail in reduction of costs of these solar cells.

2.1.2 Solar thermal technologies, also known as concentrated solar thermal (CST) technologies, typically concentrate 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.

2.2. Standards

2.2.1 Each of these technologies has different cost implications based on their efficiency, reliability, mounting, tracking, land, water and other requirements. The Commission has decided that the final selection of the technology shall be left to the Solar Power Developers. It is difficult to determine the tariff for each such technology. The Commission has decided to determine the tariff for the technology predominantly used in our country. 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 utilization 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

……

(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 procedures 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.

…….

(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 order has been prepared in consonance with the provisions of the Power Procurement from New and Renewable Sources of Energy Regulations, 2008 issued by the Commission and its subsequent amendments.

4. Power position in Tamil Nadu

4.1 The generating capacity connected to the Tamil Nadu's grid including the allocation from Central Generating stations is 13883.5 MW as on 29-2-2016 comprising of 4,660 MW from TANGEDCO's four thermal stations, 516 MW from four gas turbine stations, 2288 MW from hydro stations, 852.5 MW from private generating stations, 68 MW as contribution to Tamil Nadu grid by sale of electricity from captive generating and biomass plants, 5464 MW as Tamil Nadu's share from central generating stations.

4.2 Generating capacity from privately owned wind farms is 7512 MW as on 29-02-2016. The installed capacity of cogeneration plants is 659.4 MW and biomass power projects is 230 MW. The solar generation capacity is 581.26 MW.

4.3 The present demand in the State is around 13700 MW. The expected peak may vary from 14200 MW to 14800 MW. The peak power requirement is increasing at the rate of around 8% annually in the State. Therefore any capacity addition will help the State to a great extent.

5. Solar power projects in Tamil Nadu.

5.1 Solar plants commissioned in Tamil Nadu

5.1.1 The first 5 MW grid connected solar photovoltaic power plant was commissioned in Tamil Nadu in Sivagangai District in December 2010 under the Demonstration Programme of Ministry of New and Renewable Energy (MNRE). Out of the 7 projects each of 1 MW capacity sanctioned to Tamil Nadu under the Roof Top PV & Small Solar Power Generation Programme(RPSSGP) of Jawaharlal Nehru National Solar Mission(JNNSM), 6 projects have been commissioned from June 2011 to June 2012. Under the NTPC Vidyut Vyapar Nigam (NVVN) Bundling Scheme, one 5 MW Solar PV Power Project has been commissioned in March 2012. A total of 117.26 MW has been commissioned under REC scheme, 10 MW has been commissioned under the VGF scheme of JNSSM and 20MW under Rooftop scheme. The total installed capacity in the State as on 29/02/2016 is 581.26 MW.

6. Applicability of this order

6.1 This order shall come into force from 01-04-2016, the date succeeding the date of expiry of the control period of the last tariff order No.7 of 2014 dt.12.9.2014 read with order No.4 of 2015 dt.01.04.2015 on Solar power. The tariff fixed in this order shall be applicable to all solar power plants commissioned during the control period of this order. The tariff is applicable for purchase of solar power by Distribution Licensee from Solar Power Generators conforming to this order. The open access charges and other terms and conditions specified in this order shall be applicable to all the Solar energy generators, irrespective of their date of commissioning.

7. Tariff Determination Process

7.1 With regard to tariff determination process, the relevant portion of Regulation 4 of the Power Procurement from New and Renewable Sources of Energy Regulation, 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."

7.2 In line with the above regulation, the Commission prepared a consultative paper on

"Comprehensive Tariff Order on Solar Power", and hosted the same on 10/2/2016 in the Commission's website inviting comments and suggestions from stakeholders. The consultative paper was also presented in the State Advisory Committee(SAC) meeting held on 17/03/2016 and discussed. The abstract of the comments received from the stakeholders is annexed with this order as Annexure II. The views of the Members of the SAC presented in the meeting dt.17/03/2016 is enclosed as Annexure III. Taking into account the important comments/suggestions received from the stakeholders and the SAC Members, parameters adopted by other State Electricity Regulatory Commissions, CERC and after deliberations on all issues, the Commission issues this "Comprehensive Tariff Order on Solar Power " .

8. Tariff / Pricing Methodology

8.1 Tariff / Pricing Methodology specified in regulation 4 of the Commission's 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 decides 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 adopt 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."

8.2. Project specific or Generalized Tariff

8.2.1 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. This order mainly provides for power purchase by distribution licensees for their Renewable Purchase Obligation (RPO) compliance 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 decides to issue a generalized tariff order for solar Photovoltaic and solar Thermal projects.

8.3. Single Part or Two Part Tariff

8.3.1 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 costs could be taken care of by adopting suitable parameters. Therefore, the Commission has decided to continue with the single-part tariff for solar energy generation.

8.4. Cost-Plus Tariff Determination

8.4.1 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 and it can be easily designed to provide adequate returns to the investor. Commission in the last tariff order had adopted levelised tariff method taking into account the Accelerated Depreciation(AD) benefit as done by CERC and many other SERCs. The Commission decides to adopt the same in this tariff order.

9. Tariff Components

9.1 The tariff determined in a cost plus scenario, would depend significantly on the following operational and financial parameters:

1. Capital investment
2. Capacity Utilization Factor
3. Operation and maintenance expenses
4. Insurance cost
5. Debt-equity ratio

6. Rate of Interest and Term of Loan

7. Life of plant and machinery

8. Interest and components of Working Capital

9. Return on equity

10. Depreciation rate applicable

11. Auxiliary consumption

9.2 Capital Investment

9.2.1 The capital cost is one of the most important parameters for tariff determination of power projects. The major components of a photovoltaic power plant are PV modules, inverters, control panels, switch yard, machineries, equipment etc.. Apart from the above components, the total capital cost includes the cost of land, power evacuation lines and replacement of capital equipment if any during the life time.

9.2.2 Many stakeholders have sought an increase in the capital cost ranging from Rs.5.55.Crores/MW to Rs.6.10 Crores/MW citing high land cost, increased cost involved in civil works, mounting structures depending on soil conditions and labour cost in the State. Neyveli Lignite Corporation Ltd.(NLC) has stated that the proposed capital cost is low and that the reduction in cost of modules is off set by the increase of prices in other components and has requested to furnish the break up cost. The CERC issued a draft order No. 17/SM/2015 dated 23/12/2015 in the matter of Determination of

Benchmark Capital cost norm for Solar PV power projects and Solar Thermal power projects for the financial year 2016-17. In this order, the CERC has determined Rs.5.0132 Crores per MW for Solar PV plant. This includes module costs, land cost, cost towards civil and structural works, cost of power conditioning unit , cost of evacuation of power and preliminary and pre operative expenses including IDC. Module degradation of 0.6% has been accounted for in the capital cost. TANGEDCO has suggested to adopt the capital cost of Rs.5.0132 Crores/MW as proposed by CERC. The stakeholders have expressed views that the reduction in prices of module cost is temporary and to consider the increase in exchange rate variation. The Commission has observed that each bidding by different state utilities for solar energy finds a new low in terms of cost of energy. Various stakeholders attribute various reasons for such low tariffs. Some of them have said that these prices are unsustainable. However, the fact remains that the prices for solar energy continue to fall and has reached as low as Rs.4.34 per unit as on date.(as per available information). In view of this, the Commission is not inclined to alter the capital cost indicated in the consultative paper. The Commission decides to adopt a capital cost of Rs. 5.05 Crores per MW which includes all the components and degradation of modules.

9.2.3 In the case of solar thermal projects, TANGEDCO has proposed a capital cost of Rs. 12 Crores/MW. The Citizen consumer and civic action group(CAG) has also proposed a cost of Rs.12 Crores/MW. The CERC in the draft order No. 17/SM/2015 dated 23/12/2015 has suggested a capital cost of Rs. 12 Crores per MW. The Commission adopts a capital cost of Rs. 12 Crores per MW in this order.

9.3 Capacity Utilization Factor (CUF)

9.3.1 Many of the stakeholders have suggested a CUF of 17%. One stakeholder has requested to consider a CUF of 19.65%. Few stakeholders have requested to consider the module degradation effect in the tariff computation. The Commission has adopted the capital cost taking into account the cost of replacement of modules in respect of degradation during the life time. Most of the SERCs have considered a CUF of 19% in their orders. The Commission decides to adopt the CUF of 19% for solar PV projects and 23% for solar Thermal projects. These CUFs are considered taking into account the efficiency factors of equipment, deration etc. and fast developing technology.

9.4 Operation and Maintenance Cost (O&M)

9.4.1 In the consultative paper, the Commission proposed an O&M cost of 1.4% of capital cost with an escalation of 5.72% from the second year and a separate cost for insurance. Stakeholders have suggested to consider O&M expenses with respect to actual inflation, not to link O&M expenses with capital cost and have suggested capital costs ranging from Rs.10.9 Lakhs/MW to Rs.13.74 Lakhs/MW with escalation of 5.72%. TANGEDCO has suggested to adopt 0.75% of capital cost with an escalation of 5.72% per annum. CERC has adopted Rs.13 lakhs for the year 2015-16 with an escalation of 5.72% in the order No.004/2015 dt.31.3.2015 for Solar PV. The CERC has not accounted for the insurance cost separately. Commission has proposed O&M cost in terms of percentage of the capital cost in all its orders on renewable energy. Therefore, the Commission decides to adopt an O&M cost of 1.4% of capital cost with an escalation factor of 5.72% from the second year as proposed in the consultative

paper and as adopted in the last order.

9.5 Insurance cost

9.5.1 In the last tariff order for Solar power, Commission adopted 0.35% of net asset value as insurance cost. The Commission proposes to adopt the same in this order.

9.6 Debt-equity ratio

9.6.1 One stakeholder has recommended a debt equity ratio of 60:40. The Tariff Policy lays down a debt equity ratio of 70:30 for power projects. The Commission adopts this ratio in this order as specified in its Tariff Regulations 2005 and the earlier tariff orders on new and renewable power.

9.7 Rate of Interest and term of loan

9.7.1 TANGEDCO has suggested an interest rate of 12%. One stakeholder has suggested to consider rate of 12.3%. Other stakeholders have requested to consider interest rate of 13%. The CERC, MERC, RERC have all adopted an interest rate of 13%. The Commission decides to adopt 13% of interest rate on loan for this order as proposed in the consultative paper.

9.7.2 Stakeholders have not disputed on the term of loan proposed in the consultative paper. TANGEDCO has concurred with the proposal of the Commission regarding term of loan. The Commission decides to adopt the term as 10 years with 1 year moratorium as adopted by the Commission in its previous orders on Wind, Bagasse, Bio-mass power and Solar.

9.8 Life of Plant and machinery

9.8.1 The CERC and other SERCs have adopted a life period of 25 years. The Commission adopts a life period of 25 years in this order for Solar power projects.

9.9 Interest and Components of Working Capital

9.9.1. One stakeholder has suggested an interest rate of 12%. Another stakeholder has suggested to consider inclusion of 15% of O&M expenses towards spares. The CERC has adopted an interest rate of 13.50% in its order dt.31.3.2015. The Commission decides to adopt an interest rate of 13.50% for working capital. As to the components of working capital, the Commission decides to adopt one month Operation and Maintenance cost and two months Receivables for the solar projects as followed in its last order.

9.10 Return on Equity (RoE)

9.10.1. Many stakeholders have suggested pre tax RoE of 20% upto 10 years and 24% for the balance period as adopted by CERC. TANGEDCO has suggested to adopt a pretax RoE of 19.85%. The Tariff Regulations of the Commission stipulates 14% post tax RoE for conventional fuel based generating stations. The Commission in its orders issued in 2012 related to determination of tariff for NCES power, adopted a RoE of 19.85% without linking it to MAT and IT and considered 20% (pre tax) in the last tariff order of solar power. It is decided to adopt a RoE of 20% (pre tax) per annum for Solar Power Generators(SPGs) without linking it to MAT and IT in this order also.

9.11 Depreciation

9.11.1 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 at the rate of 1.54% for the balance useful life of the project beyond the initial period of 12 years. Few stakeholders have requested to adopt the CERC formula. 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. This translates into a rate of 3.6% per annum. In the last tariff order on solar power, depreciation was calculated on 95% of the capital investment. The Commission decides to adopt the depreciation rate of 3.6% per annum following the same method in this order also for the life period of 25 years.

9.12 Auxiliary Consumption

9.12.1. CERC has considered 10% Auxiliary consumption in respect of solar thermal projects. The Commission decides to adopt the same in respect of solar thermal plant. Stakeholders have recommended to consider Auxiliary consumption of 0.25% to 0.5% for solar PV plants. The CERC has not adopted Auxiliary consumption for solar PV plant for determination of tariff. Having considered efficiency related issues in the CUF, the other constituents of Auxiliary consumption such as lighting, general maintenance etc., there is negligible consumption of electricity. The Commission has decided not to take into account the Auxiliary consumption for determination of tariff for solar PV plant.

9.13. Tariff Determinants

9.13.1 The financial and operational parameters adopted in respect of Solar Photovoltaic and Solar Thermal projects proposed in this order are tabulated below:

Tariff Components	Solar PV	Solar Thermal
Capital Cost	Rs.5.05 Crores per MW	Rs.12 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	13%	13%
Life of plant and machinery	25 years	25 years
Working capital components	One month O&M cost and Two months Receivables	One month O&M cost and Two months Receivables
Interest on Working capital	13.5%	13.5%
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 factor	10.21%	10.21%
Levelised Tariff without AD	5.10	11.12
Levelised Tariff with AD	4.56	9.95

10. Solar Power Tariff

10.1 The levelised Solar power tariff is computed with reference to the determinants above. The tariff works out to Rs.5.10 per unit for Solar PV projects and Rs.11.12 per unit for Solar Thermal projects without AD benefit. The AD benefit component of the tariff is Rs.0.54 per unit for solar PV and Rs.1.17 per unit for Solar Thermal. The tariff for the developers / generators availing AD benefit will be the tariff arrived at after deduction of AD benefit from the tariff as determined above. The respective working sheets are enclosed in Annexure IA and IB.

11. 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. Control Period and Tariff Period

11.1. Quantum of solar power purchase by the distribution licensee

11.1.1 The distribution licensee can purchase solar power at the rate determined by the Commission from SPG for his RPO requirement. 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 the Commission. For any procurement in excess of RPO, specific approval shall be obtained from the Commission.

11.2 Plant Capacity Limitations

11.2.1 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 decides to adopt the same in this order also.

11.3. CDM Benefits

11.3.1 In the earlier orders issued on renewable energy and in the last tariff order for solar power, 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."

11.3.2 The Commission decides to adopt the same formula in this order also. The distribution licensee shall account for the CDM receipts in the next Aggregate Revenue Requirement filing.

11.4 Billing and payment

11.4.1 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 Commission has considered two months receivables as a component of working capital. Therefore, the distribution licensee shall make payment to the generator in 60 days of receipt of the bill in complete shape. One stakeholder has suggested to incorporate appropriate payment security mechanism in the EPA to ensure timely payment for the power procured and to consider interest rate of 1.5%. Commission in its orders on renewable energy issued in 2009 and 2012 has not considered payment security mechanism. TANGEDCO has suggested to waive the interest charges for delayed payment considering the utility's financial commitment. However, the Commission adopts 1% interest per month for any delayed payment by the distribution licensee beyond 60 days.

11.5 Energy Purchase Agreement (EPA)

11.5.1 The format for Energy Purchase Agreement (EPA) shall be evolved as specified in the Commission's " Power procurement from New and Renewable source of Energy Regulations 2008" and as amended from time to time. The agreement shall be valid for 25 years. In their comments, TANGEDCO has reported that they may execute EPA with the solar power generators after finalizing power evacuation. The distribution licensee shall convey its decision on purchase of power in line with this order within a month of receipt of the proposal from the generator for selling power. In case of refusal to purchase power, valid reason in line with this order shall be communicated to the SPG by the distribution licensee. The EPA shall be executed within the reasonable time in line with this order. The agreement fees are governed by the Commission's Fees and Fines regulation.

11.6. Control Period and Tariff Period.

11.6.1 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."

11.6.2 As the Capital cost is volatile in respect of Solar Power Plants, the Commission proposed one year control period in its consultative paper. One stakeholder has requested the Commission to consider the analogy adopted by CERC on applicability of control period for solar PV by allowing the tariff determined for the control period in the order to projects commissioned in the subsequent financial year subject to the condition that PPAs are signed on or before the last day of the year for which generic tariff is determined and the entire capacity covered by the PPAs are commissioned on or before 31st March of the next year. Yet another stakeholder has suggested to adopt a control period of two years. CERC's approved capital cost for solar PV for the year 2015-16 was Rs.6.0585 Crores per MW and the cost as per the draft order for benchmark capital cost for solar PV is Rs. 5.0132 Crores per MW that accounts for the drop in module prices over the years 2014-15. Market reports suggest that while earlier reduction in prices were due to competitive pricing, the prices are set to reduce further due to adoption of advanced technology and automations in manufacturing. Therefore, the Commission decides to retain the one year control period in this order as proposed in the consultative paper and in consonance with the Commission's regulations on Power Procurement from New and Renewable Sources of Energy.

12. 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 power evacuation.
11. Harmonics
12. Parallel operation charges

12.1 Open Access charges and Line Losses

12.1.1 Regarding Open access charges and line losses, one stakeholder has suggested to waive the charges as notified in the Tariff Policy,2016 for wind and solar power. Another stakeholder has sought exemption from the above charges. The cost of

transmission network established for the required purpose of transmission has to be recovered from the user, based on the capacity allotted to them. 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 sections 61(h) and 86(1) (e) of the Act, the Commission decides to adopt 30% in each of the transmission, wheeling, scheduling and system operation charges to solar power on the respective charges specified in the relevant orders issued by the Commission from time to time. Apart from these charges, the SPGs shall have to bear the actual line losses in kind as specified in the relevant orders of the Commission and as amended from time to time. In respect of the plants availing Renewable Energy Certificate (REC), 100% of the respective charges as specified in the relevant orders will apply.

12.2 Cross subsidy surcharge

12.2.1 One stakeholder has suggested to limit the cross subsidy to 10% of applicable tariff or to waive the same completely quoting the provisions in the revised tariff policy that surcharge shall not exceed 20% of the tariff applicable to the category of consumers seeking open access and the Electricity Amendment Bill,2014 tabled in the Lok Sabha that proposes exemption of cross subsidy for purchase of power from renewable power. The distribution licensee loses the cross subsidy surcharge component if the open access consumer is a subsidizing consumer which is the underlying principle on which the present provisions of the Electricity Act specifies the

cross subsidy surcharge. The Commission in its earlier tariff orders relating to different renewable power including Solar, has ordered to levy 50% of the cross subsidy surcharge for third party open access consumers, as a promotional measure, under sections 61(h) & 86(1) (e), of the Act. The .Commission decides to adopt the same for Solar power in this order also.

12.3 Reactive Power Charges

12.3.1 Commission decides to adopt the reactive power charges for solar power plants as specified in its Order on Open Access charges issued from time to time.

12.4 Grid Availability Charges

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

12.4.1.1 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 open access consumers. This is also applicable to the existing SPGs from the date of this order.

12.4.2 Stand by charges

12.4.2.1 If the drawal by the captive user or third party buyer exceeds their respective 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.

12.5. Energy Accounting and Billing Procedure

12.5.1 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. This billing procedure provides a banking period of one billing cycle as in the last solar order. The licensee shall record the slot wise generation and consumption during the billing period. Slot wise adjustment shall be made for the billing period. However, 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 applicable solar tariff fixed by the Commission in the respective orders to the generator and has to be settled within three months of the respective billing period.

12.6 Energy Wheeling Agreement and Fees

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

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

12.7 Security Deposit

12.7.1 As regards the security deposit to be paid by captive/third party user, the Commission decides to retain the present arrangements. Accordingly the charges corresponding to two times of 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.

12.8 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.

12.9 Metering

12.9.1 The metering and communication shall be in accordance with the following regulations in force:

(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 Grid Connectivity and Intra State Open Access Regulations 2014

Metering procedure is also governed by any specific orders of the Commission on metering and ABT as and when it is issued.

12.10. Connectivity and Evacuation of power

12.10.1. 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, 2012 shall be complied with. The connectivity and power evacuation system shall be provided as per the Act / Codes/ Regulations/orders in force.

12.11. Harmonics

12.11.1 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.

12.12. Parallel operation charges

12.12.1 Solar power generators who consume power captively in the same location but wish to avail Renewable Energy Certificate(REC) may opt for paralleling of their generators with the grid without actually wheeling their power. Such generators shall have to pay 30% of applicable parallel operation charges to the respective distribution licensee as specified in the relevant regulations.

13. Directions

13.1 Quarterly reports on the quantum of energy wheeled from the solar generators for captive consumption and third party sale shall be furnished to the Commission by Tamil Nadu Transmission Corporation(TANTRANSCO)/State Load Despatch Centre(SLDC). Similar report on the solar energy purchased shall be furnished by the distribution licensee.

14. Acknowledgement

14.1 The Commission acknowledges with gratitude the contribution of the officers and staff of the Commission, the valuable guidance provided by the SAC members

and the efforts taken by the stakeholders in offering their suggestions. The Commission is indebted to the valuable inputs offered by the Tamil Nadu Generation and Distribution Corporation Ltd.

Sd./-	Sd./-	Sd./-
(T.Prabhakara Rao)	(G.Rajagopal)	(S.Akshaya Kumar)
Member	Member	Chairman

(By Order of the Commission)

Sd/-
(S.Chinnarajalu)
Secretary

Capital cost	50500000
PLF	19.00%
Depreciation	3.60%
Interest	13.000% (10 + 1) yr.
Dt:Eq.	70 &30
O & M	1.4% with 5.72 % escl.
Insurance	0.35 % of net asset value
Residual value	10%
ROE	20.00%
Life of Plant	25 Yr.
Aux.consump.	0%
W.Cap.	O&M 1m +Receivables 2m.
Inst. On W.Cap.	13.50%
Discount factor	10.21%

ANNEXURE IA

Solar PV MW scale

Tariff Details--- Solar.(PV)

Gross Gen	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400
Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
ROE	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000	3030000
Depreciation	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100	1727100
Insurance cost	176750	170705	164660	158615	152571	146526	140481	134436	128391	122346	116302	110257	104212	98167	92122	86077	80032	73988	67943	61898	55853	49808	43763	37718	31674
Interest on Loan	4595500	4595500	4135950	3676400	3216850	2757300	2297750	1838200	1378650	919100	459550														
O & M	707000	747440	790194	835393	883178	933695	987103	1043565	1103257	1166363	1233079	1303611	1378178	1457010	1540351	1628459	1721606	1820082	1924191	2034255	2150614	2273629	2403681	2541171	2686526
IOWC	243756	245013	235772	226616	217549	208576	199703	190935	182279	173741	165328	157046	159481	162064	164802	167705	170782	174043	177499	181160	185038	189146	193497	198105	202985
Total	**10480106**	**10515759**	**10083677**	**9654125**	**9227247**	**8803197**	**8382137**	**7964236**	**7549677**	**7138651**	**6731358**	**6328014**	**6398971**	**6474341**	**6554375**	**6639341**	**6729521**	**6825213**	**6926732**	**7034412**	**7148605**	**7269684**	**7398042**	**7534095**	**7678285**
	6.297	**6.318**	**6.058**	**5.800**	**5.544**	**5.289**	**5.036**	**4.785**	**4.536**	**4.289**	**4.044**	**3.802**	**3.845**	**3.890**	**3.938**	**3.989**	**4.043**	**4.101**	**4.162**	**4.226**	**4.295**	**4.368**	**4.445**	**4.527**	**4.613**
IOWC																									
O & M	58917	62287	65849	69616	73598	77808	82259	86964	91938	97197	102757	108634	114848	121417	128363	135705	143467	151674	160349	169521	179218	189469	200307	211764	223877
Receivables	1746684	1752626	1680613	1609021	1537874	1467200	1397023	1327373	1258280	1189775	1121893	1054669	1066495	1079057	1092396	1106557	1121587	1137536	1154455	1172402	1191434	1211614	1233007	1255683	1279714
Total	1805601	1814913	1746462	1678637	1611473	1545007	1479281	1414336	1350218	1286972	1224650	1163303	1181343	1200474	1220758	1242262	1265054	1289209	1314805	1341923	1370652	1401083	1433314	1467447	1503591
IOWC	243756	245013	235772	226616	217549	208576	199703	190935	182279	173741	165328	157046	159481	162064	164802	167705	170782	174043	177499	181160	185038	189146	193497	198105	202985
Discount Factor	1	0.91	0.82	0.75	0.68	0.62	0.56	0.51	0.46	0.42	0.38	0.34	0.31	0.28	0.26	0.23	0.21	0.19	0.17	0.16	0.14	0.13	0.12	0.11	0.10
Present Value	**6.30**	**5.73**	**4.99**	**4.33**	**3.76**	**3.25**	**2.81**	**2.42**	**2.08**	**1.79**	**1.53**	**1.30**	**1.20**	**1.10**	**1.01**	**0.93**	**0.85**	**0.79**	**0.72**	**0.67**	**0.61**	**0.57**	**0.52**	**0.48**	**0.45**
Levelised tariff	**5.10**																								

Determination of accelerated depreciation benefit

Depreciation amount	90%																								
Book depreciation rate	5.28%																								
Tax depreciation rate	80%																								
Income Tax (Normal rate)	33.990%																								
Capital Cost	50500000																								
Years	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Book Depreciation	2.64%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	2.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Bk dep in lakhs	1333200	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	2666400	1454400	0	0	0	0	0	0	0
Accelerated Depreciation																									
Opening	100%	50%	5%	1.00%	0.20%	0.04%	0.01%	0.00%	0.000%																
Allowed	50%	45%	4.00%	0.80%	0.16%	0.03%	0.01%	0.000%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Closing	50%	5%	1.00%	0.20%	0.04%	0.01%	0.00%	0.000%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Accelerated Depreciation	25250000	22725000	2020000	404000	80800	20250	6750	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net dep benefit	23916800	20058600	-646400	-2262400	-2585600	-2646150	-2659650	-2666400	-2666400	-2666400	-2666400	-2666400	-2666400	-2666400	-2666400	-2666400	-2666400	-1454400	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tax benefit	8129320	6817918	-219711	-768990	-878845	-899426	-904015	-906309	-906309	-906309	-906309	-906309	-906309	-906309	-906309	-906309	-906309	-494351	0	0	0	0	0	0	0
Discount factor	1.00	0.91	0.82	0.75	0.68	0.62	0.56	0.51	0.46	0.42	0.38	0.34	0.31	0.28	0.26	0.23	0.21	0.19	0.17	0.16	0.14	0.13	0.12	0.11	0.10
Average discount factor	1.00	0.95	0.87	0.79	0.71	0.65	0.59	0.53	0.48	0.44	0.40	0.36	0.33	0.30	0.27	0.24	0.22	0.20	0.18	0.17	0.15	0.14	0.12	0.11	0.10
Net Energy gen	832200	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400	1664400
Energy gen with DCF	832200	1587303.89	1440253.96	1306826.93	1185760.76	1075910.32	976236.56	885796.72	803735.34	729276.24	661715.12	600412.96	544789.91	494319.85	448525.41	406973.42	369270.87	335061.13	304020.62	275855.75	250300.11	227111.97	206072.02	186981.24	169659.05
Tax benft with DCF	8129320	6502108	-190123	-603783	-626112	-581412	-530241	-482339	-437655	-397110	-360321	-326941	-296652	-269170	-244234	-221608	-201078	-99518	0	0	0	0	0	0	0
AD benefit	0.54																								
Levelised tariff with AD	4.56																								

Proj. cost	120000000
PLF	23.00%
Depreciation	3.60%
Interest	13.000% (10 + 1) yr.
Dt:Eq.	70 &30
O & M	1.4% with 5.72 % escl.
Insurance	0.35 % of net asset value
Residual value	10%
ROE	20.00%
Life of Plant	25 Yr.
Aux.consump.	10%
W.Cap.	O&M 1m +Receivables 2m.
Inst. On W.Cap.	13.50%
Discount factor	10.21%

ANNEXURE IB

Solar Thermal

Tariff Details--- Solar.(Thermal)

Gross Gen	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800	2014800
Net Gen.	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320
Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	
ROE	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	7200000	
Depriciation	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	4104000	
Insurance	420000	405636	391272	376908	362544	348180	333816	319452	305088	290724	276360	261996	247632	233268	218904	204540	190176	175812	161448	147084	132720	118356	103992	89628	75264	
Interest on Loan	10920000	10920000	9828000	8736000	7644000	6552000	5460000	4368000	3276000	2184000	1092000															
O & M	1680000	1776096	1877689	1985092	2098640	2218682	2345591	2479758	2621601	2771556	2930089	3097690	3274878	3462201	3660239	3869605	4090946	4324948	4572335	4833873	5110370	5402683	5711717	6038427	6383825	
IOWC	579223	582210	560251	538493	516948	495626	474542	453708	433139	412850	392858	373178	378966	385103	391610	398508	405819	413568	421779	430478	439694	449456	459796	470745	482340	
Total	**24903223**	**24987942**	**23961212**	**22940494**	**21926131**	**20918488**	**19917948**	**18924918**	**17939828**	**16963131**	**15995307**	**15036865**	**15205476**	**15384572**	**15574753**	**15776652**	**15990941**	**16218328**	**16459562**	**16715435**	**16986785**	**17274496**	**17579505**	**17902801**	**18245429**	
	13.733	**13.780**	**13.214**	**12.651**	**12.092**	**11.536**	**10.984**	**10.437**	**9.893**	**9.355**	**8.821**	**8.292**	**8.385**	**8.484**	**8.589**	**8.700**	**8.819**	**8.944**	**9.077**	**9.218**	**9.368**	**9.526**	**9.695**	**9.873**	**10.062**	
IOWC																										
O & M	140000	148008	156474	165424	174887	184890	195466	206647	218467	230963	244174	258141	272907	288517	305020	322467	340912	360412	381028	402823	425864	450224	475976	503202	531985	
Receivables	4150537	4164657	3993535	3823416	3654355	3486415	3319658	3154153	2989971	2827188	2665885	2506144	2534246	2564095	2595792	2629442	2665157	2703055	2743260	2785906	2831131	2879083	2929917	2983800	3040905	
Total	4290537	4312665	4150009	3988840	3829242	3671305	3515124	3360800	3208438	3058151	2910059	2764285	2807152	2852612	2900812	2951909	3006069	3063467	3124288	3188729	3256995	3329306	3405894	3487002	3572890	
IOWC	579223	582210	560251	538493	516948	495626	474542	453708	433139	412850	392858	373178	378966	385103	391610	398508	405819	413568	421779	430478	439694	449456	459796	470745	482340	
Discount factor	1	0.91	0.82	0.75	0.68	0.62	0.56	0.51	0.46	0.42	0.38	0.34	0.31	0.28	0.26	0.23	0.21	0.19	0.17	0.16	0.14	0.13	0.12	0.11	0.10	
Present value	13.73	12.50	10.88	9.45	8.20	7.09	6.13	5.28	4.55	3.90	3.34	2.85	2.61	2.40	2.20	2.02	1.86	1.71	1.58	1.45	1.34	1.24	1.14	1.06	0.98	
Levelised tariff	11.12																									

Determination of accelerated depreciation benefit	
Depreciation amount	90%
Book depreciation rate	3.60%
Tax depreciation rate	80%
Income Tax (Normal rate)	33.990%
Capital Cost	120000000

Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	
Book Depreciation	2.64%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	2.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
Bk dep in lakhs	3168000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	6336000	3456000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Accelerated Depreciation																										
Opening	100%	50%	5%	1%	0.20%	0.04%	0.008%	0.002%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Allowed	50%	45%	4%	0.80%	0.16%	0.03%	0.006%	0.001%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Closing	50%	5%	1%	0.20%	0.04%	0.01%	0.002%	0.000%	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
AD	60000000	54000000	4800000	960000	192000	36000	12000	1536	0.00%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Net dep benefit	56832000	47664000	-1536000	-5376000	-6144000	-6300000	-6324000	-6334464	-6336000	-6336000	-6336000	-6336000	-6336000	-6336000	-6336000	-6336000	-6336000	-3456000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Tax benefit	19317197	16200994	-522086	-1827302	-2088346	-2141370	-2149528	-2153084	-2153606	-2153606	-2153606	-2153606	-2153606	-2153606	-2153606	-2153606	-2153606	-1174694	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Energy gen	906660.00	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	1813320	
Discount factor	1	0.91	0.82	0.75	0.68	0.62	0.56	0.51	0.46	0.42	0.38	0.34	0.31	0.28	0.26	0.23	0.21	0.19	0.17	0.16	0.14	0.13	0.12	0.11	0.10	
Av DCF	1.00	0.95	0.87	0.79	0.71	0.65	0.59	0.53	0.48	0.44	0.40	0.36	0.33	0.30	0.27	0.24	0.22	0.20	0.18	0.17	0.15	0.14	0.12	0.11	0.10	
DCF En gen	906660	1729326	1569119	1423754	1291855	1172176	1063584	965052	875649	794527	720921	654134	593534	538548	488657	443387	402311	365040	331222	300538	272695	247433	224510	203711	184839	
Tax benefit with DCF	19317196.80	15450552.87	-451776.62	-1434732.03	-1487790.35	-1384235.81	-1260783.13	-1145875.40	-1039972.11	-943627.72	-856208.80	-776888.48	-704916.51	-639612.11	-580357.60	-526592.51	-477808.28	-236478.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
AD benefit	1.17																									
Levelised tariff with AD	9.95																									

Annexure II

Abstract of comments received from various stakeholders on "Consultative Paper on Comprehensive Tariff Order for Solar Power"

1. Capital cost/MW in Crores

M/s OPG Power Generation Private Ltd.

The Commission should go into a detailed working of capital cost based on complete bill of materials for Solar PV power plant. Modules from leading manufacturers are available at USD 0.52/Wp to 0.54/Wp. The INR is depreciating continuously during the current financial year. Module cost of USD 0.52/Wp (DC) and an exchange rate of Rs. 70/- for FY2016-17 that works out to Rs.3.64 Crores may be considered. CERC's draft order on Solar PV cost does not include civil foundation for MMS, cost towards SCADA, weather monitoring etc. The same may be reviewed and considered.

M/s. Welspun Renewables Energy Private Ltd.

A module price of $0.50 - $0.51 per Wp may be considered instead of $0.465 taken by CERC in their paper on 'Capital cost on Benchmarking' brought out in December 2015. The forecast for Indian Rupee predicted on 11.2.2016 projects exchange rate of USD at Rs.75 by the end of 2016. An exchange rate of Rs.72 is proposed. Civil and general works cost should account for ground soil condition, general contour of the ground, ground water table, basic wind speed, presence of aggressive chemicals, salt in weather, availability of raw materials. Civil and general cost of Rs.45 Lakhs /MW and mounting structure cost of Rs.45 Lakhs /MW is suggested.

Evacuation cost of Rs.65 Lakhs per MW as below may be considered:

a) DC cables – Rs.15 Lakhs
b) String combiner box/Junction box/SCADA – RS.10 Lakhs
c) AC cables/Transformers – Rs.25 Lakhs.
d) For balance works of telemetry, solving ROW issues etc. –Rs.15 Lakhs.

A capital cost of Rs.610 Lakhs/MW as follows is suggested:
PV modules – Rs.360 Lakhs/MW
Land cost –Rs.25 Lakhs/MW
Civil and general works – Rs.45 Lakhs/MW
Mounting structures – Rs.45 Lakhs/MW
Power conditioning unit – Rs.30 Lakhs/MW
Evacuation cost – Rs.65 Lakhs/MW
Preliminary and Operative expenses
Including IDC and contingency } - Rs.40 Lakhs/MW

Specific factors that affect commissioning of projects in Tamil Nadu and that have a cost implication are Utility rating, Volatility in Tariff orders, process of PPA signing, Wind Speed, No. of approvals/clearances required to be obtained in the State, non availability of solar parks, cost of manpower etc.

Thiru S. Narayanaswamy, Former Member (Generation),TNEB

Cost of solar panels and invertors cost 50% of the project cost. The capital cost may be increased by 10% to Rs.5.55 Crores/MW due to the increase in exchange rate, labour cost for projects up to 5 MW. Cost of laying roads may also be taken into account. For projects above 5MW, an increase of 5% may be considered or alternatively, awarded through competitive bidding. The Consumer Price Index has an increase of about 6 % from March 2015 to Dec 2015 which indicates increase in labour cost. Reflection on cost of construction work similar to approving increase in O&M charges at 5.72% over previous year may be considered. Difference in capital cost between developing small and large projects may be considered. TANGEDCO is collecting interconnecting line maintenance charge of Rs 16,300/- per MW per year which is not collected in other states. There should be difference in approach between small entrepreneurs and bigger companies as bigger companies go for international loan.

M/s Siant Energy Solutions Private Ltd.

Cost of Rs.5.05 Crores/MW does not include transmission line costs from SPV plant to sub station and setting up of a bay station within sub station premises. A project cost of Rs.6.50 Crores with single axis tracker and Rs.6 Crores/MW for fixed tilt may be considered.

M/s Neyveli Lignite Corporation Ltd.

Capital cost proposed by the Commission is low. Break up of capital cost may be furnished. CERC has given the split up cost in the draft benchmark cost for the FY2016-17 published. The cost of PV modules is on the decline but cost of land, civil and general works, mounting structures, evacuation cost, preliminary and pre operative expenses are not on the decline. Decline in the cost of PV modules alone may be considered retaining cost of other non module components, and appropriate module degradation cost may be loaded in the capital cost.

TANGEDCO

CERC in their draft order on benchmark capital cost dt.23.12.2015 for Solar PV and Solar thermal has suggested capital investment of Rs.5.0132 Crores/MW for Solar PV and Rs.12 Crores/MW for Solar Thermal. The same may be considered.

M/s Adani Green Energy Ltd.

It appears that the Commission has adopted the Central Commission's draft order dt.23.12.2015 on benchmark capital cost of Solar PV projects.
Suggestion on capital cost:

i. Module price – As per the MERCOM Solar report dated 1.2.2016, the PV price trend in Europe for the month of December scarcely saw any changes in module prices over the previous month. The United States has extended the 30% Investment Tax Credit benefit beyond the year 2016 and the heavy US demand is expected to continue in 2017 as against earlier expectation of moderation. Then it is expected that China will also continue to be the largest Solar PV Generation country. Thus it is unlikely to expect that Solar PV Prices will see similar trend as seen in FY 14-15 and FY 2015-16. Price of module at USD 0.49/Wp may be considered.

Domestic manufacturer's module price has not been considered. The cost of Indian modules will be higher. DC size of the plant is always higher than the AC size. Due to higher size, developer needs to purchase 10% to 20% higher module quantity. Therefore, Commission may consider the module requirement for 1 MW AC project @ 1.1 MWp – 1.2 MWp. Exchange rate of Rs. 69.5 may be considered. The annual degradation for Solar PV may be factored.

ii Land Cost - For Promoting technologies like motorized Trackers, Seasonal Tilt, and Thin Film, etc. the land area should be 6 Acres/MW. The land cost of INR 6 Lakh/Acre may be considered i.e. Rs.36 Lakhs.

iii Power Conditioning Unit – Most of the inverter needs a major overhaul / replacement in 12^{th} to 14^{th} year of operation. Inverter cost should be kept at INR 40 Lakhs per MW.

iv. Module Mounting Structures-Rs.60 Lakhs /MW

v. Total civil and general cost – Rs.50 Lakhs/MW

vi. Cables and Transformers – Rs.60 Lakhs/MW.

vii. Preliminary /pre operative – 10% of corresponding project cost.

viii. Balance of system costs – Rs.275 Lakhs/MW

A capital cost of Rs.600 Lakhs /MW may be considered.

Development of solar projects across various geographic & climatic conditions entails wide variations in costs of civil works i.e. foundation, Mounting Structure, etc.

Citizen Consumer and Civic Action Group

The Capital expenditure may be revised to Rs 5.0132 Crores/MW for Solar PV and Rs 12 Crores/MW for Solar Thermal Projects as in CERC draft order.

Dinamalar

Fixing a tariff of Rs.6 Crores/MW would be a workable solution for Solar PV.

M/s Hindustan Power

The average module prices in the international market are between 0.54 to 0.57 USD per Watt and exchange rate is around Rs.67 to 68/USD currently. Considering the average module prices i.e., 0.56 USD/Watt and an exchange rate of Rs.67.09/ USD, the module price works out to Rs.3.75 Crores/MW. As far as non module component is concerned, cost considered by CERC may be considered. Capital cost of Rs.5.66 Crores/MW may be considered.

2. Capacity Utilization Factor

M/s OPG Power Generation Private Ltd

No differentiation has been made between the AC and DC capacity for Solar PV power plant. It is presumed that DC capacity of the plant has been considered and AC and DC capacity kept the same. Commission may consider qualifying the DC capacity in the order.

Thiru S. Narayanaswamy Former Member (Generation)

The average daily Solar incidence in Tamil Nadu is less compared to Rajasthan, Gujarat & Madhya Pradesh. 19% CUF is applicable only to higher solar incidence states and not relevant to Tamil Nadu. Degradation in efficiency may be considered separately. The degradation works out to 0.5% average per year and the estimated annual generation may be revised keeping CUF of 17% in the 1st year.

M/s Siant Energy Solutions Private Ltd

CUF of 19% is for fixed tilt only. In projects where single axis trackers are used a CUF of 24% may be considered.

M/s Neyveli Lignite Corporation Ltd

The degradation of solar cells that ranges from 0.6% to 0.3% is to be taken into account in computation of tariff. If appropriate module degradation cost is not provided in the capital cost of SPV Projects, it may be considered in the tariff computation by progressive reduction in CUF.

M/s Adani Green Energy Ltd.

Solar insolation in Tamil Nadu is significantly lower compared to high insolation area like Rajasthan and Gujarat with difference of up to 2% CUF.

Citizen Consumer and Civic Action Group

To arrive at the CUF some more analysis should be taken up. CUF of 19.65 % given by MNRE as the benchmark may be considered.

Dinamalar:

CUF at 17% may be considered.

M/s Hindustan Power

Global Horizontal Irradiation data suggests a lower CUF of around 17-18% in the State of Tamil Nadu. For the purpose of determining the tariff, CUF of 17 – 18% may be considered.

3. Operation and Maintenance Expenses

M/s Neyveli Lignite Corporation Ltd.

The O&M expenses may not be linked to project cost in the context of falling SPV project rates, since it gives rise to fictitious and conflicting O&M values. The O&M expenses as Rs 13.74 Lakhs per MW for 1st year of control period 2016-17 as per CERC Renewable Regulations and escalated at 5.72% thereafter may be adopted.

TANGEDCO

O&M cost of 0.75% with an escalation of 5.72% from second year may be adopted.

M/s Adani Green Energy Ltd.

O&M expenses with respect to actual inflation and other inputs data, at least Rs.10.9 Lakhs/MW/Year +5.72% inflation may be considered.

Citizen Consumer and Civic Action Group

Break up details for arriving at O&M expenses may be given. CERC's break up be taken into account for arriving at O&M expenses while maintaining O&M expense at 1.4% of capital cost of solar projects with an escalation of 5.72%.

M/s Hindustan Power

O&M expense in absolute term of at least Rs.12.6 Lakhs/MW with annual escalation of 8% may be considered.

4. Insurance cost

M/s Adani Green Energy Ltd.

0.35% of net asset value as insurance cost is agreed to.

Citizen Consumer and Civic Action Group

The basis for arriving 0.35% insurance cost may be explained. For insurance cost, the CERC norms may be followed.

M/s Hindustan Power

O&M expense of at least Rs.12.6 Lakhs /MW with annual escalation of 8% may be considered.

5. Debt- Equity Ratio

M/s Adani Green Energy Ltd.

Debt equity ratio of 70:30 is agreed.

Dinamalar

Debt equity ratio of 60:40 may be considered or else if debt equity ratio of 70:30 is followed, then the bank interest of 9% is suggested to make the projects economically viable.

6. Rate of Interest and Term of Loan

TANGEDCO

Rate of interest at 12% may be adopted.

M/s Adani Green Energy Ltd.

Loan tenure of 10 years with 1 year moratorium and rate of interest of 13% is agreed.

Citizen Consumer and Civic Action Group

The rate of interest may be revised from 13% to 12.30% for solar power projects since, as per latest SBI's base rate, the base rate has been reduced from 9.70% to 9.30%. For the term of loan, the principles set out by CERC may be followed.

M/s Hindustan Power

Rate of interest of 13% and term of loan is accepted. The average loan and interest thereon may be computed by using quarterly opening loans for arriving at yearly average loan.

7. Life of Plant and Machinery

M/s Adani Green Energy Ltd.

Life period of 25 years for Solar power projects is agreed.

Dinamalar

To be realistic, degradation at an accelerated level of 70% at the end of 25th year may be considered.

8. Interest and components of Working Capital

M/s Neyveli Lignite Corporation Ltd.

Inclusion of 15% of O&M expenses towards spares in working capital as per CERC Renewable Regulation may be considered.

TANGEDCO

Interest rate of 12% on working capital is suggested.

M/s Adani Green Energy Ltd.

One month O&M cost and 2 months receivables as working capital components and an interest rate of 13.5 % is agreed.

Citizen Consumer and Civic Action Group

The interest on working capital may be revised to 12.80% since the SBI base rate has been reduced from 9.7% to 9.3% with effect from 05.10.2015.

M/s Hindustan Power

Maintenance spares at 15% of O&M expenses may be included and interest on working capital shall be at interest rate equivalent to the average State Bank of India Base rate prevalent during the first six months plus 350 basis points.

9. Return on Equity

Thiru S. Narayanaswamy, Former Member (Generation)

ROE as 20% for the 1st 10 years and 24% for the rest of the years as adopted by CERC may be considered.

TANGEDCO

ROE at the rate of 19.85 % per annum for SPG linking it to MAT and IT may be considered.

M/s Adani Green Energy Ltd.

ROE may be specified on pre-tax basis in line with CERC and norms stipulated by various other SERCs. Pre-tax ROE of 20% for the first 10 years and 24% from 11th year onwards may be stipulated.

10. Depreciation

M/s Adani Green Energy Ltd.

Higher depreciation rate may be specified during the loan tenure for solar power project as per the principle adopted in the CERC. A depreciation rate of 6.36% for first 11 years and 1.43% for remaining useful life may be adopted.

Citizen Consumer and Civic Action Group

CERC guidelines to calculate depreciation may be adopted. If appropriate measures to ensure repayment of loan have been adopted by TNERC, it is requested to provide explanation as to where such items are accounted for in the draft tariff order.

M/s Hindustan Power

Depreciation may be allowed equal to the repayment during loan tenure of 10 years and distributed to the remaining useful life of the project.

11. Auxiliary consumption

M/s OPG Power Generation Private Ltd

0.5 % of energy generation under auxiliary consumption may be considered which includes air conditioning of inverters, SCADA of Solar PV power plants, bore wells to meet water requirement for module cleaning, drinking & sanitary purpose, annunciation and illumination required at the control/inverter rooms, switch yard, entrance, boundary wall and strategic locations during night time.

Thiru S. Narayanaswamy Former Member (Generation),TNEB

0.25% Auxiliary Consumption as adopted by GERC considering perimeter fence lighting and Electrical yard lighting may be considered.

M/s Adani Green Energy Ltd.

Many State Commissions have provided Auxiliary Consumption at 0.25% and the same may be specified.

M/s Hindustan Power

Auxiliary consumption of at least 1% may be fixed.

12. Tariff Determinants

Thiru S. Narayanaswamy Former Member (Generation),TNEB

Accelerated depreciation is only a deferred payment of IT and not a gain to developers. The developers are discriminated on the ground of Accelerated depreciation. Concession for MW size solar power projects similar to roof top solar power developers is suggested. Deduction in tariff towards availing Accelerated Depreciation may be removed.

M/s OPG Power Generation Private Ltd.

Telengana Regulatory Commission has brought innovative ideas like target commissioning incentive, Attractive Tariff (2016-17) for upcoming Solar Power Projects. It is suggested to incorporate the above.

M/s Adani Green Energy Ltd.

The discount rate of 11.96 % as per corporate finance principal adopted by CERC may be adopted.

Citizen Consumer and Civic Action Group

A section for "Discount Rate" may be inserted and the rationale spelt in line with CERC's explanation.

M/s Hindustan Power

Commission has used a discount factor of 10.21%. No explanation for selecting the discount factor of 10.21% has been given.

13. Solar Power Tariff

Dinamalar

Tariff at Rs 6/- per unit may be fixed.

Siant Energy Solutions Private Ltd.

Rs 6.25 per unit or at the very least Rs 6.00 per unit may be considered.

14. CDM benefits

Citizen Consumer and Civic Action Group

It is suggested to closely monitor the CDM benefits accruing to the developer be shared with TANGEDCO.

15. Billing and Payments

M/s Neyveli Lignite Corporation Ltd.

Interest rate of 1.5% for delayed payment may be considered. A payment security clause enabling adjustment of any receipts first towards late payment interest,

thereafter towards arrears, statutory levies, taxes, duties and lastly power dues may be included in the EPA.

TANGEDCO

It is suggested to waive interest for delayed payment considering the financial commitment of TANGEDCO and tariff rate payable to the generator.

M/s Hindustan Power

The proposal to raise the bill every month for the net energy sold after deducting the charges for power drawn from distribution licensee, reactive power charges etc. amounts to double count of deductions as the net energy sold would have accounted for the drawal of energy by SPG.

16. Energy Purchase Agreement

TANGEDCO

It is suggested that TANGEDCO may execute PPA with the SPG after finalising power evacuation.

17. Control Period and Tariff period

M/s Neyveli Lignite Corporation Ltd.

Commission may consider the analogy adopted by CERC on applicability of control period for solar PV by allowing the tariff determined for the control period in the order to projects commissioned in the subsequent financial year subject to the condition that PPAs are signed on or before the last day of the year for which generic tariff is determined and the entire capacity covered by the PPAs are commissioned on or before 31st March of the next year.

TANGEDCO

It is suggested that control period could be 6 months from date of issue of order considering varying nature of capital cost, whereas 1 year considering the practical difficulty in tariff fixation.

M/s Hindustan Power

A reasonable period for commissioning the project from conception would be two years. Thus Commission may consider a control period of two years for solar power as done by CERC.

18. Open Access charges and Line losses

M/s Neyveli Lignite Corporation Ltd

The revised Tariff policy dt.28.1.2016 stipulates that in order to encourage renewable sources of energy, no inter state transmission charges and losses be levied till such period as may be notified by Central Government. Therefore intra state transmission and wheeling charges and losses may be waived for solar power.

TANGEDCO

30% of transmission, wheeling charges, scheduling and system operation charges are acceptable. 100% charges may be adopted for plants availing REC.

M/s Hindustan Power

Solar power plants may be exempted from transmission and wheeling charges as well as transmission and wheeling losses. Metering of Solar power generation is done at the outgoing feeder of the SPG switchyard and the SPGs who will sell the power to the Distribution licensee, the losses will be accounted on part of the buyer, distribution licensee. Accordingly, an amendment may be issued.

19. Cross subsidy surcharge

M/s Neyveli Lignite Corporation Ltd

The revised tariff policy stipulates that cross subsidy surcharge should not exceed 20% of the tariff applicable to the category of consumers seeking open access. In the Electricity Amendment Bill 2014 tabled in the Lok Sabha , it has been proposed to exempt cross subsidy charges for renewable power. Therefore, cross subsidy surcharge may be limited to either 10% of the applicable tariff or be waived completely.

TANGEDCO

Cross subsidy surcharge of 50% may be considered for third party open access consumers.

20. Reactive Power charges

TANGEDCO

Commission's views acceptable.

21. Grid availability charges

TANGEDCO

Commission's views acceptable.

22. Energy Accounting and Billing procedure

TANGEDCO

At the end of the billing month, the balance energy may be paid at the rate of 75% of the applicable solar tariff.

23.Energy wheeling agreement and fees

TANGEDCO

Commission's views acceptable.

24. Security Deposit

TANGEDCO

Commission's views acceptable.

25. Power factor disincentive

TANGEDCO

Commission's views acceptable.

26. Metering

TANGEDCO

Commission's views acceptable.

27. Connectivity and Evacuation of power

TANGEDCO

Commission's views acceptable.

M/s Hindustan Power

In case the Hon'ble Commission decides to allow delivery point at Licensee's sub station instead of generator's switchyard/pooling sub station, the cost of evacuation/transmission line would fall within the scope of the generator. An

additional cost needs to be factored in towards construction, operation and maintenance etc. of transmission line from the generators sub station to delivery point of power procurer. The losses due to intervening line are also to be considered. A normative cost of Rs.42.5 lakhs/Km and normative loss of 0.1% per km may be considered.

28. Harmonics

TANGEDCO

Commission's views acceptable.

29. Parallel operation charges

TANGEDCO

Parallel operation charges at 100 % for those who wish to avail REC and 30% for those who do not opt for REC benefit may be considered.

Annexure III

MINUTES OF THE 29th MEETING OF STATE ADVISORY COMMITTEE OF TAMIL NADU ELECTRICITY REGULATORY COMMISSION HELD ON 17th MARCH 2016 AT GULMOHAR HALL, HOTEL GRT GRAND, T.NAGAR, CHENNAI – 17.

Members Present:

1. Thiru S. Akshaya Kumar, Chairman, TNERC
2. Thiru G. Rajagopal, Member, TNERC
3. Dr. T. PrabhakaraRao, Member, TNERC
4. Dr. M. Saikumar, CMD, TNEB Ltd. & TANGEDCO Ltd. and Chairman, TANTRANSCO Ltd.
5. Thiru R.K. Kulshreshta, Chief Electrical Engineer, Southern Railways
6. Dr. A.S. Kandasamy, Member, SAC
7. Thiru T. Vijayarangan, Member, SAC
8. Thiru K. Alagu, Member, SAC
9. Thiru Ramesh Kymal, Member, SAC
10. Thiru C. Muthusami, Member, SAC
11. Thiru G.S. Rajamani, Member, SAC
12. Thiru K. Kathirmathiyon, Member, SAC

Chairman, TNERC welcomed the members of the State Advisory Committee. He introduced the new member of the Commission, Dr.T.Prabhakara Rao, to the members of the committee. He expressed condolence to the demise of SAC member Thiru Desikan who had actively participated in many of the meetings of the SAC and offered valuable suggestions. He further stated the purpose of the meeting convened to discuss the consultative papers issued on issue of comprehensive tariff orders on Wind,Bio-Mass, Bagasse and Solar power. These papers were hosted in the Commission's website inviting comments/suggestions from stakeholders and now being placed before the State Advisory Committee. He requested the Director/Engineering and Director/Tariff to make the presentations on the subject.

The Director/Engineering first made the presentation on Wind power on the issues dealt in the consultative paper.

Chairman/TNERC requested the members to offer their views on the various issues on wind power. The views expressed by the members of the SAC are as follows:

Dr. A.S. Kandasamy - Electricity is a commodity that cannot be stored even for a fraction of a second. The word banking is a misnomer. When generation is idle, it develops only pressure. The utilization begins only when load is connected. The units generated in a month should be settled for payment in the same month. The energy exported to TANGEDCO should be billed as per the rates decided by the Commission. Wind power is highly infirm in nature. During the wind season, when the generation to the tune of 4000 MW all of a sudden fails, the Licensee and the consumers are made to suffer. He strongly recommended removal of banking. He raised question as to whether depreciation is linked to straight line method or sinking fund method as per the provisions of the Act. He fully agreed with the proposal of Commission and suggestion of TANGEDCO for removal of deemed demand.

Thiru Ramesh Kymal, President,CII – He has stated that banking is just a book adjustment. The grid is large enough to handle the variations. In Tamil Nadu most of the investments are for captive use and not for feed in tariff. Banking is essential as during the high wind season the captive users cannot use the entire energy generated. He further added that if a reasonably high tariff is given, the proposal of the Commission could be considered. Regarding the components for tariff, he expressed the following views:

CUF and capital cost - The World Institute of Sustainable Energy has found out that the potential for wind in Tamil Nadu is 2 Lakh MW. Only 7000 MW has been exploited so far. He suggested that problems in utilizing the entire generation in the State could be solved technically by exporting part of the generation outside the State during the windy season. The potential of present wind sites are with a CUF of 25%. To capture the wind at such potentials, technically advanced machines are required and that raises the capital cost. The capital cost ex-factory is Rs.5.5 Crores/MW and for the entire project inclusive of land, grid connectivity etc. the cost is Rs.7 Crores/MW.

Discounting factor - CERC's discounting factor of 10.87% may be considered.

Useful life - He agreed to the useful life period of 25 years adopted which could be possible due to the advancement in technology.

Return on equity – He suggested to consider a return on equity of 20% for the first 10 years and 24 % for the remaining years as adopted by CERC.

Depreciation – CERC's guidelines of 5.83% for the first 10 years and 1.54% for the remaining years may be considered.

Working capital and interest – TANGEDCO does not make payments within one month. Interests are not really coming down . He suggested that interest may be retained at 13.5 % in line with CERC.

O&M expense – Commission's rate of O&M works out to Rs.5.57 Lakhs/MW. An amount of Rs.5 Lakhs would go for manpower and the rest for insurance. This would hardly leave anything for consumables. He suggested Rs.10.63 lakh/MW with escalation of 5.72% p.a as adopted by CERC. Considering the parameters as suggested above would work out to a tariff of Rs.4.72 per kWhr. He reiterated his opinion on banking earlier stated.

Dr. A.S. Kandasamy – He has stated that though banking is a book adjustment and a scientific method of calculating the banking charges have been devised, the proposal of removal of banking should be considered.

Thiru Ramesh Kymal – Banking is said to be a problem because the entire energy generated is being tried to be utilized within the state. If the power is allowed to be sent out of the state through the national grid the problem of banking would be reduced to a large extent. The State is blessed with wind power before the monsoon sets in the North. The vast potential of energy available should be allowed to be exported outside the state.

Thiru G.S. Rajamani– He congratulated the Commission for the excellent consultative paper and the precise presentation made. He said that by convention, O&M expenses are treated as a composite rate. The idea is not to go into the details of how it is being spent. He felt that insurance charges should be a part of O&M and not to be provided as a separate charge. Insurance charges varies from company to company. He further queried as to whether reactive charges are being measured and whether SLDC has taken steps to control the reactive power.

CMD/TANGEDCO – TANGEDCO's suggestion on interest rate given was 12%. This is a regime of falling power tariff and falling interest rates. Rates of interest of 13% - 13.5% proposed by the Commission is on the higher side. Even the interest rate of 12% is slightly higher. TANGEDCO's suggestion of tariff rate is Rs.3.32 per unit assuming an interest of 12%. Regarding banking, he said that banking was a

concept introduced in 1986. This was to encourage renewable energy . Now the installed capacity of wind power is 7500MW. The banked units are drawn at a time when the licensee is in trouble. During the high demand season, the banked units that are a low cost power are drawn, and TANGEDCO has to meet the demand by purchase of power at high cost and subsidise the banked units. In Andhra Pradesh, the banked units are not allowed to be drawn during the months when the utility has to meet high demand. During January, February the utility supplied about 275 MU per day but the same could not be translated to revenue due to the drawal of banked units. Unless the banking concept is suitably modified or completely removed, the euphoria of wind power will not be there. The state is blessed with wind power. But the problem is, as Dr.Kandasamy mentioned, the power is highly infirm. Now forecasting of wind power has improved but TANGEDCO requires proper scheduling from the wind power generators. When generation is not as per schedule, the wind energy generators should store energy or buy from the market and provide to TANGEDCO. That is what western countries are doing. Indian Wind Power Association had taken people to Norway, Denmark where 100 % wind is used. After scheduling, if there is 25 to 30% shortfall, TANGEDCO has either to go for load shedding or buy power from the open market and supply, and when TANGEDCO enters the open market, the power that was selling at Rs.4 per unit becomes Rs.10 per unit. Somebody has to have storage facility. Either wind power has to be stored or the generators can have diesel generators and provide power as per schedule. California is using diesel generators. TANGEDCO had an experience of shortfall in power supply during the month of September, due to the sudden fall in wind power generation, when its thermal units were shutdown for absorbing more wind power. Inspite of having surplus power, TANGEDCO had to resort to load shedding for 5 days when the assembly session was going on. Such a thing has not happened in the history of any Board. Everybody can profit but there should not be profiteers. He stated that banking has to be dispensed with or allowed with certain restrictions by permitting them to draw during periods of low demand and restricted during high demand seasons peak like done in Andhra. A proper scheduling should be done so that TANGEDCO will know when to back down their thermal stations, and when wind power is not as per schedule, the onus should be on the wind power generator to provide as per schedule or some sort of penalty system should be brought in, say, through amendment of PPAs. Unless these kind of measures are taken, banking will

be redundant. The installed capacity will go up to 8000 MW and when 6000 MW is to be banked, and drawn during the months of October to April, the utility will be in trouble.

Thiru Ramesh Kymal - He said that his views presented on banking and tariff were on the investors point of view. Tariff rates coming down is actually a mirage. One cannot look at the Solar prices coming down which are not sustainable. Coal prices will not be low for a long period. The tariffs for wind are not fixed on a weekly basis. The decision being taken this day will hold for the entire control period. Therefore a balanced view has to be taken on the tariff for the renewable energy sector.

Thiru K.Kathirmathiyon: He said that while determining tariff, global warming needs to be considered and renewable energy is to be encouraged. Government of India has fixed a target of 40% renewable energy to be achieved by 2030. At the same time, licensee's problems have also to be looked into. Due to the wind potential in the State, installed capacity of wind power is high, which is 70% of TANGEDCO's installed capacity. Wind power may be a problem to TANGEDCO as power is intermittent but at the national level it has to be encouraged. He suggested that TANGEDCO may take necessary steps to evacuate the entire wind energy and sell to outsiders. CAG has pointed out that TANGEDCO has not evacuated the power. Only after complete evacuation, banking needs to be considered. For the past few days, wind energy is being evacuated completely by the licensee. Banking was introduced as an encouragement to the wind sector. The licensee actually sells the banked units and gets an average cost of power. During periods of peak demand, drop in wind power affects the licensee and licensee has to purchase power at high cost. Therefore banking could be thought of with certain restrictions. Banking could be for a period of six months. It is also noticed that during the last year only 60 MW has been installed. Renewable energy has to be encouraged. All components taken for tariff determination in the consultative paper is at the lower end. The tariff is lower than that fixed by many other Electricity regulatory commissions like RERC. GERC, CERC, MERC. The minimum tariff was Rs.3.61 and maximum was Rs.6.34. If reasonable tariff is fixed and the entire power is evacuated, the wind mill generators could be encouraged. Regarding, banking charges, the proposed rate as a difference of marginal cost of power and the wind

tariff is not viable. It could be fixed as the difference in the cost of energy supplied to the industry and the wind power tariff.

Dr. A.S.Kandasamy - He stated that he is not against revision of tariff. A remunerative price has to be given to the investor. CMD/TANGEDCO has said that the utility's financial resources have gone down. The licensee's liability is to be considered. Banking charges could be raised or tariff marginally increased.

Thiru R.K. Kulshrestha, Chief Electrical Engineer, Railways - He raised the issue of harmonics wherein 15% compensation charges are being asked to be paid for exceeding prescribed limits. The latest wind energy units installed are as per international standards which have inbuilt remedies for harmonics. This should be taken into consideration. He further said that evacuation problems still persist in the state. In respect of their 10MW plant in ICF, CUF has come down due to low evacuation. Banking is not an issue for Railways as they consume all the power. They have abandoned the idea of creating additional capacity in the state and have moved to other states like Rajasthan. He requested to consider this issue also.

Dr. A.S.Kandasamy :Harmonics not only distort the source voltage. It is high pollutant. Harmonics are produced by the loads. Harmonics passes through the transmission/distribution lines and reaches the alternator wherein the emf is generated. This modifies the entire sinusoidal wave. The machines are stated to have inbuilt harmonic filters. He expressed doubts about the functioning of the filters. He cited a case where the measurements showed that the harmonic filtering units were not functioning well. When voltage is distorted, other consumers get affected. Current harmonic affects the utility. It is for TANGEDCO to measure and take effective steps.

Thiru R.K.Kulshrestha, Railways – He suggested that harmonics may be verified at the time of installation itself. Voltage harmonics only are of relevance and current harmonics should not be taken into consideration. Only the state of Tamil Nadu levies charges for harmonics. No other state has enforced penal charges. If the licensee has invested in suppressing of harmonics, levy of penal charge may be relevant. Similar is the case of power factor. For leading P.F, Kerala gives incentives. In Andhra also it is the same. A comparison may be made with other states and then levy of penalty proceeded with.

Dr. A.S.Kandasamy– The utility does not require leading power factor. It affects the grid. He said that he does not agree with payment of incentives for lead power factor. He said that harmonics should also be measured and penalty levied.

Chairman/TNERC requested Director/Engineering to make the presentation on the issues dealt in the 'Consultative paper for issue of comprehensive tariff order on Solar power'.

Director/Engineering gave the presentation on the 'comprehensive tariff order on solar power'

The views of the members of the SAC are as below:

Dr. A.S.Kandasamy– Many of the educational institutions want to install solar power. Educational institutions may be allowed to install rooftop solar power. Net metering may be permitted and they may be allowed to export power at the rates fixed for the solar power by the Commission. Solar power needs to be encouraged. The State does not have coal reserves. Solar power is more firm than wind power. Regarding the auxiliary consumption, he stated that invertor will consume some power. The details of current consumption by the invertor are available in the nameplates. He requested the Commission to look into this aspect.

Thiru R.K.Kulshrestha, Railways – Railways has lot of scope for rooftop solar. There is availability of land too. Allowing export of power through net metering may be considered. The life of plant specified as 25 years needs to be reconsidered. Even if one follows the MNRE specification, it is difficult that the plant achieves a life period of 25 years.

Thiru Ramesh Kymal– Net Metering is the only way to have Distributed generation in the factories. When it comes to quality standards solar has no quality standard unlike wind where the price difference band is less than 10%. In the case of Solar, the price difference is over 70% and the reduced price of solar panels is not sustainable as it is a supply demand mismatch and is not due to technological breakthrough and so fixing of tariff should be carefully done. Here again the tariff is not fixed weekly and it is for a period of time. This may be taken into account while fixing the feed in tariff.

CMD/TANGEDCO – He said that TANGEDCO suggests an interest rate of 12% on capital and 12% on working capital and keeping the above rates in view the tariff works out to Rs.4.66. Rajasthan's tariff rate is Rs 4.23. He pointed out that on 16.3.2015, the highest quantum of solar power of 450MW of 600 MW was

evacuated. Solar is a firm power compared with wind so TANGEDCO could evacuate it. There was a mention about non evacuation of wind**.** If there is 6000 to 7000 MW of solar power, it can be certain that between 12 to 1 PM, there will be a generation of 4000 MW. To that extent, TANGEDCO can switch off the thermal stations and evacuate**.** But inthe case of wind, unless there is an assurance on the quantum of supply by way of alternate supply from other sources, evacuation will be a problem. Grid is not a problem. Banking is a problem. It is a vicious cycle. Evacuation is a problem because of unreliability of wind power. Solar power is reliable when compared to wind. TANGEDCO suggests Rs 4.66 per unit for Solar power.

Member I – He has stated that there are two ways of fixing the tariff. One is preferential tariff fixed by the Commission u/s 86(1)(e) and the other is adopting the tariff obtained in the tender floated by the licensee through competitive bidding process. By going for competitive bidding, in different states lower tariffs have been discovered due to severe competition and aggressive bidding. Rajasthan has got around Rs.4.34 per unit and Andhra has got Rs.4.63 per unit. So, TANGEDCO also may consider the same.

Chairman/TNERC - He said that not only for Solar, but in all other cases, the feed in tariff which is fixed by the Commission is the benchmark rate and the utility is free to go for competitive bidding if they are finding a price which is lesser. It is only that the ceiling is fixed. It is only the RPO which is actually to be met. To meet the RPO, like in any other conventional power the utility can go for merit order and fill the gap, till the RPO limit is reached.

CMD/TANGEDCO - TANGEDCO already has PPAs with feed in tariffs, for about 1500 MW, out of which till March it is assumed that only 600 or 650 MW will be commissioned and not more than 700 MW. So this will be relevant only for those who fail to commission before 31stMarch. They will have to go by the new tariff. That is why TANGEDCO has suggested to fix the cost at Rs 4.66. Further, as per State Solar Policy the utility requires at least 3000 MW. For another 1500 MW, TANGEDCO has to go for a tender. This has to be taken up after the elections when the model code of conduct is lifted. CMD stated that TANGEDCO will take up the tender process considering the ceiling fixed by the Commission and hopes to get a further reduction in price.

Thiru Ramesh Kymal - He stated that wind during high wind season is not infirm. Forecasting helps to a certain extent but scheduling is very important for the utility to manage the grid. Wind energy generators are taking steps for proper scheduling. Scheduling has to be done from the generator end as well as from the consumption side. On the low tariffs for solar power, he said that the companies who have won the bids are all companies who have funds from abroad at very low interest rates and the panels are being imported. It has to be seen whether these are sustainable. Hon'ble Commission should consider the above while fixing the tariff.

Thiru K.Kathirmathiyon – Tamil Nadu Government's steps in fixing a target of 3000 MW power and making solar power compulsory in Government buildings is a welcome measure. Net metering should be considered in a large measure as solar power also helps in reducing global warming as in the case of wind. Recent reports in newspapers suggest that forecasting accuracy of wind has reached 80%. He has suggested that all the amendments issued to various regulations may be updated and consolidated.

CMD/TANGEDCO – There is 65% reliability in forecasting done by wind. Proper scheduling of power will help the utility. Forecasting and scheduling requires separate discussion.

Thiru C.Muthusami – Solar power needs to be encouraged. Small scale industries use rooftop solar power. Attractive tariffs needs to be fixed.

After completion of the presentation and discussion in respect of Consultative Papers on Wind and Solar, Director/Tariff presented the important parameters adopted for determination of Tariff for Bagasse based Co-generation Plants and Biomass based Power Plants.

Director/Tariff discussed the details relating to the Capital Cost of the Project, Station Heat Rate, GCV, and the resultant Specific Fuel Consumption for generation of power, tariff proposed in Consultative Paper and its parameters. Director/Tariff after his presentation clarified the doubt raised by Dr.A.S. Kandasamy, SAC Member in regard to the method of Depreciation adopted. He clarified that the Straight Line Method of Depreciation is adopted by the Commission for calculating the Depreciation. Further, he clarified with respect to the query raised by Thiru. G. S. Rajamani, Member, SAC that the insurance forms part of O & M Charges,

however it is provided separately as per Hon'ble APTEL's directives in Appeal against Wind Tariff Order of 2012 issued by the Commission.

Dr. A.S.Kandasamy, Member, SAC - He enquired whether the presentation made by Director/Tariff for Biomass also includes the Biogas projects. Further, he suggested that instead of calling as Non-Conventional Energy Sources, the same may be called as Renewable Energy Sources.

Chairman/TNERC – Clarified that there are other sources like Municipal Solid Waste, Biogas. TANGEDCO has already signed agreement with them. Separate Orders will be issued later.

CMD/TANGEDCO – In Co-gen Power Plants, during non-crushing season coal is used as fuel. The procurement of power from Bagasse based Co-generation Plant is subject to Merit Order Dispatch and if lower tariff is fixed the same will not come under Merit Order Dispatch and they can supply power to TANGEDCO. Now they are discounting and instead of discounting the Commission may fix a lower tariff.

Chairman/TNERC - Renewable Energy is considered as separate and they have been assigned must run status. These energies do not come under Merit Order Dispatch. Grid Security alone can stop functioning of any of these machines. With respect to usage of Coal, the moment the Co-gen Plant uses more than 15% of the Coal, they lose the NCES status and will come under the regular conventional power plant. TANGEDCO need not take whatever is available. It has to comply only with Renewable Purchase Obligation (RPO) and has to decide on how much they can dispatch. Lot of resources are coming in and there are tariff with and without Accelerated Depreciation benefits. First we may go in for the tariff with Accelerated Depreciation and the rest can be utilized later. TANGEDCO can take commercial decisions.

Member (I)/ TNERC – Bagasse based Co-gen also uses coal as input and in such case we should have dual tariff.

CMD / TANGEDCO – The Dispatching is done based on MOD and the variable cost is Rs.3.91 per unit and the total cost is Rs.4.70 and Rs.4.90. The power plant has to give discount to come within the MOD and getting dispatched. Hence, instead of fixing higher tariff and then the generators giving discount, Commission can fix a lower tariff. The Load Dispatch Centre issues dispatch instructions to cheaper power and for the must run also the tariff may be fixed

between Rs.4.20 to Rs.4.30 per unit. The dispatch of power is related to farmers' issue, sugar cane price, payment to farmers will also become an issue. Hence, instead of fixing at a higher tariff, Commission may fix a lower tariff. There will be moderation. If I don't dispatch then all sugar mills will complain that TANGEDCO is not paying and hence, they were not able to pay the farmers.

In reply to the issue raised by CMD/TANGEDCO, the Chairman/TNERC has replied that TNERC has fixed certain tariff and Appeal has also been filed against the Orders of TNERC. Hon'ble APTEL has given directions to redo it and the Commission has no other way than to follow the directions and to fix the tariff. TNERC has to fall in line with CERC & APTEL to fix the tariff.

The matter of solar bundled power was raised and the Chairman/TNERC clarified that it is not hybrid, the new Tariff Policy talks about the renewable generation obligation which means that every Conventional power plant has to necessarily have a quantum of renewable power. The cost will be bundled and the rate will be fixed by CERC as per norms and it will be scheduled separately.

Thiru R.K.Kulshreshta, Member, SAC- He stated that the Railways is going to purchase directly and some people are offering bundled power. He further stated that they don't have any issues like banking.

Chairman/TNERC – has stated that the new tariff policy enable the Railways to be a Deemed Utility and it need not pay CSS. Further, more concessions are also offered to Railways.

Member (I) - thanked all the members for their participation and valuable suggestions made and assured that all information given would be considered by the Commission.