

**CENTRAL ELECTRICITY REGULATORY COMMISSION  
NEW DELHI**

**Petition No. 17/SM/2015**

**Coram: Shri Gireesh B. Pradhan, Chairperson  
Shri A. K. Singhal, Member  
Shri A. S. Bakshi, Member  
Shri M.K.Iyer, Member**

**Date of Order: 23<sup>rd</sup> March 2016**

**IN THE MATTER OF**

Determination of Benchmark Capital Cost Norm for Solar PV power projects and Solar Thermal power projects applicable during FY 2016-17

**ORDER**

The Commission notified the Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2012 (hereinafter "RE Tariff Regulations") on February 6, 2012.

**2** The first proviso of Regulation 5 of RE Tariff Regulations provides that the Commission may annually review the benchmark capital cost norm for Solar PV and Solar thermal power projects.

**3** In exercise of powers under Regulation 5 of RE Tariff Regulations, the Commission vide Order dated 31<sup>st</sup> March, 2015, determined the Benchmark Capital Cost Norm for Solar PV power projects for the year 2015-16 (Petition No. SM/005/2015 -Suo-Motu) at Rs. 605.85 lakhs/MW, and for Concentrated Solar Power (CSP) projects at Rs.12 crores/MW.

**4** Accordingly, the generic tariff for Solar PV projects notified vide Order dated 31<sup>st</sup> March, 2015, in Petition No. SM/005/2015 and applicable for the financial year 2015-16 is Rs. 7.04/unit, and Rs.6.35/unit with AD benefit. For Solar Thermal power projects, levellised tariff for 2015-16 is Rs.12.05/unit, and Rs.10.80/unit with AD benefit

**5** The Commission, in due discharge of the mandate under Regulation 5 of RE Tariff Regulations, proposes to determine the benchmark Capital Cost Norm for Solar PV and Solar Thermal power projects applicable during FY 2016-17, vide Petition No. 17/SM/2015 dated 23/12/2015. Comments were invited from all stakeholders till 10th January, 2016.

6 In response, written comments/suggestions/objections were received from the following stakeholders:-

1. NHPC
2. TATA POWER SOLAR
3. ADANI GREEN ENERGY LTD
4. UJAAS
5. GREEN ENERGY ASSOCIATION
6. OPG POWER GENERATION PVT LTD
7. ASSOCIATION OF POWER PRODUCERS (APP)
8. SUZLON
9. SUNEDISON ENERGY INDIA LTD
10. HINDUSTAN POWER
11. NSL RENEWABLES
12. WELSPUN
13. SOLAR POWER DEVELOPERS ASSOCIATION (SPDA)
14. NATIONAL SOLAR FEDERATION OF INDIA (NSEFI)

Subsequently, a public hearing was held on 29<sup>th</sup> February, 2016, and the following stakeholders made submissions during the hearing:

1. Ujaas Energy Ltd
2. OPG Power
3. Tata Power Solar
4. Green Energy Association

The issues raised by the stakeholders, the comments/suggestions received, and the analyses/decisions of the Commission thereon are presented as under:

## SOLAR PHOTO-VOLTAIC

### 1. Module Prices

#### Commission's Proposal

The total module cost is proposed at Rs 310.19 lakhs/MW.

#### Comments Received

1.1 NHPC informed that as per its MOU with Govt. of Kerala where a solar power project of 50 MW is envisaged for installation in the water bodies, Module Cost is Rs 332.35 lakhs per MW wherein floating mounting structures are required.

1.2 OPG POWER GENERATION PVT. LTD suggested CERC should consider today's market price of USD 0.52/Wp as the of cost of these modules, as reduction in module prices in FY 2016-17 are only speculative, based on likely depreciation of YUAN.

1.3 ADANI GREEN ENERGY LTD suggested \$0.49 per Wp as the price of imported modules and Domestic Module cost of \$0.61 - \$0.62 per Wp. They cited that the data produced by the CERC in Table 1 for consideration of Module Price trend has shown a decreasing price trend from Nov 2014 till Mar2015 and then there is an upward (increasing) trend from April 2015 till Sep. 2015. Since, the Indian solar industry mostly depends upon the Asian module manufacturing market; consideration of a drop of 11% in module price is absolutely unjustifiable. Noteworthy that the Investment Tax Credit available in US which was expiring next year has now been extended for the next 5 year. India, doesn't have any tariff barrier, thus prices in India are generally lowest in the world (dumped modules from China etc.) and thus can't reflect the decline otherwise evident in other parts of the world.

1.4 HINDUSTAN POWER commented module price may be taken as average of all the markets (i.e. Germany, Japan China and Taiwan) given in `pvxchange` or `PVinsights data`.

1.5 SUNEDISON ENERGY INDIA LTD and NSEFI, giving the reference of study of the Supply chain for Solar in India by the FICCI Solar Energy Task Force Report, specify the pricing difference of Chinese vs Indian manufacturers. Indian manufactures need to incur several additional transaction costs to serve in the Indian market including CST, warehousing and logistics, costlier electricity, etc, as compared to foreign manufacturers who supply directly to order. It is suggested that the cost of Indian made modules and cells to be 17% higher than the average of the Chinese module costs; making cost of Indian modules to be \$ 0.57 per watt. Also, DC size of the plant is always higher than the AC size. Due to higher size, developer needs to purchase 10%- 20% higher module quantity. This has been allowed in National Solar Mission and other state programs. Therefore, it is requested to consider the module requirement for 1 MW Ac project at 1.1 MWp - 1.2 MWp and arrive at the module cost accordingly.

1.6 TATA POWER SOLAR suggested that the proposed module cost of \$0.465/W for 2016-17 be enhanced to \$0.48/W for the following reasons:

-The considered module prices do not reflect the existing situation, and a hindrance in sourcing quality products from Tier 1 manufacturers and which would be needed to generate reliable power over a period of 25 years.

-Prices of modules are firming up on the back of firming up of cell and wafer prices. Cell prices have increased between 27% to 31% in the period Nov.-Dec. 2015.

- Prices are firming up on the back of increased demand from US and China and continued tight supply of wafers. The Chinese Government has extended the deadline for 2015 feed-in tariffs approved by the end of 2015 so they need to be completed and on grid by the end of June 2016, and this is expected to cause rush for PV installation during the fourth quarter of 2015 and the first half of 2016.

-Capacity per project in India is set to increase with promotion of capacity addition through solar parks. Most solar developers in India have found it difficult to contract large capacities from a single supplier in view of the low module prices they have assumed while bidding with adverse effects on timelines of execution and adherence to standard quality norms for the asset as a whole.

1.7 TATA POWER SOLAR has also stated that the cost of Indian modules and cells shall be higher as compared to their global counterparts; CERC may consider the cost of Indian made modules and cells to be USD 0.54/ W.

1.8 SUZLON commented module spot prices are dependent on demand-supply scenario and in no way defines the annual price variation availability at that particular rate to the actual project investor. Due to huge global demand there is upward trend seen in module prices. Also, the reference data of pvXchange shows that the regional prices in Jan'15 in China and Taiwan are same as in Oct'15. Even assumptions based on the exchange traded value are highly speculative and should not be considered for benchmark costing. Apart from this, there should be consideration for the raw material (ingots) regional cost trends which can help in cost assumptions. Analysis for chances of cost escalation, comparing it with the global economic scenario, supported by econometric modelling to arrive at an average cost is also needed. Analysis of economic parameters can be a better indicator for cost assumption. Demand –supply scenario governs the cost variability in all markets.

1.9 GREEN ENERGY ASSOCIATION commented that there is a threat to the Indian module manufacturing due to up gradation of the cell technology in China. Presently entire

module manufacturing in the country is having the facility of handling 3 Bus Bar cells and has no provision to handle / upgrade it to 4 Bus Bar without changing the tabbing line in total which is the major cost in the module manufacturing line. Further the entire leading A and B grade Chinese / Taiwanies / Korean cell manufacturers have upgraded to 4 and 5 Bus bar cells which has further increased the cost of the 3 Bus bar cells available to Indian module manufacturers or forcing them to shift to C and D grade cell manufacturers. This has further increased the cost of the Indian modules with imported cells. Also, due to installation capacity addition of 125 GW in china due to which in the later half of the last year either there was refusal to supply of modules to the Indian projects or were supplied at premium.

1.10 UJAAS ENERGY LIMITED commented that in analysis of the module prices the correct period should be April 2015 till October 2015 or for that matter from May 2015 to October 2015 as upto March 2015 has already covered in the previous order and in last financial year. Also, the data of last 6 months is showing the prices of modules showing strength. It is also incorrect to say that demand in China and US were due to year end. The demand is more lasting because of the extension of US tax credit and huge investment in renewable commitments by Chinese government in Paris summit and also to prevent the falling economy of the country.

1.11 WELSPUN commented that Indian solar industry mostly depends upon the Asian module manufacturing market and therefore, consideration of a drop of 11% in module price is unjustifiable. The consideration of 13.33% in Germany's market while calculating the benchmark cost for Indian market is unjust as the Indian market is a developing market whereas the Germany's market has reached its saturation. It is requested to consider \$0.485 - \$0.490 per Wp at present as the benchmark price for foreign modules used in the country for capex calculation instead of \$0.465 per Wp. Further, the domestic manufacture industry is also a major part of Indian solar market and is growing gradually, thus it is suggested to consider the price of domestic content while setting the benchmark cost of Solar PV.

1.12 UJAAS has submitted that whole study has been based only on imported modules, however the Solar PV plant, which is been commissioned in country fall under three categories i.e.

(a) Imported module: The same has been elaborated and discussed above.

(b) Domestic Module with Imported Cell: India has more than 1500 MW capacity to manufacture Domestic Module with Imported cell. Approx. 1000 MW is operational. The prices of domestic module cant be ignored. Estimation of prices on imported module alone will be injustice to domestic manufacturers. The price quoted by manufacturers is Rs.38/Wp. Hence the price per MW with additional module of 0.5% per year should be in excess of Rs.392 Lacs.

(c) Domestic Module with Domestic Cell: The focus of Indian government is on Make in India. Domestic Content Requirement is mandatory in many tender. It's expected that more than 1500 MW of tender will come in FY2016-17 as well. The price of PV module in this category is been quoted by manufacturer as Rs.42/Wp. Hence per MW price after considering additional MW for degradation comes in excess of Rs.435 Lacs per MW.

1.13 Solar Power Developers Association (SPDA) has stated that the data produced by the CERC in Table 1 for consideration of Module Price trend has shown a decreasing price trend from Nov'2014 till Mar'2014 and then there is an upward (increasing) trend from April'2015 till Sep'2015. The percentage drop in the price of Module was 13.33% in Germany, 5.19% in Japan, Korea, 5.97% in China and only 5.26% in South East Asia. Since, the Indian solar industry mostly depends upon the Asian module manufacturing market and therefore, consideration of a drop of 11% in module price is unjustifiable. They requested the Hon'ble CERC to consider \$0.485 - \$0.490 per Wp at present as the benchmark price for foreign modules used in the country. Further, the domestic manufacture industry is also a major part of Indian solar market and is growing gradually, thus it is suggested that price of domestic content is considered while setting the benchmark cost of Solar PV.

1.14 TATA POWER SOLAR requested to take cognizance of the DC: AC ratio. The cost of the modules considered should be as per the installed capacity (DC capacity) which is required to realize the AC capacity at the grid sub-station after deduction of various losses. The normative DC capacity to be considered is 120% of the AC capacity.

### **Analysis and Decision**

**Several stakeholders have pointed out that assuming a drop of 11% in module prices might be unjustified, as the module prices have stabilized over last few months. Module price trends, starting April 2015, are as below:**

Country	Germany	Japan, Korea	China	Southeast-Asia, Taiwan
Apr-15	0.65	0.69	0.59	0.52
May-15	0.67	0.73	0.62	0.55
Jun-15	0.66	0.73	0.63	0.55
Jul-15	0.64	0.72	0.63	0.55
Aug-15	0.63	0.72	0.63	0.55
Sep-15	0.65	0.72	0.64	0.54
Oct-15	0.65	0.73	0.63	0.54
Nov-15	0.63	0.70	0.59	0.52
Dec-15	0.64	0.70	0.60	0.51
Jan-16	0.64	0.72	0.61	0.52

Table 1: Crystalline PV Module Costs  
Source: pvXchange.com

Mercom has also reported stagnant prices for Chinese/Taiwanese modules for past several months in their newsletter. This sentiment has been echoed in stakeholder comments.

While the spot prices reflect short term market rates, for planned projects, it is a standard practice for developers to negotiate price and quantity ahead of time. However, given quality concerns and to ensure life of 25 years, we must consider Tier-1 module prices. Industry players such as Adani Power, Tata Solar, Welspun etc. have also suggested that module prices be considered at \$0.48/W. Thereby, the Commission sets module prices at \$0.48/W, assuming prices are expected to be fairly stable in the coming year.

Regarding the domestic content requirement, the Commission would like to clarify that the present exercise of benchmark capital cost is for generic tariff and not for project specific projects.

Some stakeholders have requested that module costs should be considered 10-20% higher than the rated capacity. Additional modules are deployed by some developers to optimize the performance of the plant, especially the inverters. Nevertheless, additional units of electricity are generated with the extra module capacity, resulting in higher earnings of feed-in-tariff. The Commission is of the view that the remuneration due to additional units generated sufficiently covers additional costs in such a case.

## **2. Exchange Rate**

### Commission's Proposal

Average exchange rate for Rupees to US \$ for the past six months (May 2015-Oct 2015) as per RBI is Rs. 64.58. This exchange rate has been considered for this exercise.

### Comments Received

2.1. OPG POWER GENERATION PVT LTD suggested INR has been depreciating continuously during the current financial year. The current rate of 1 USD is INR 67.15. The exchange rate of Rs 64.58 USD is unrealistic.

2.2. Ujaas Energy Ltd commented that average rate of past six months may not be proper indicator of the exchange rate, as movement of foreign exchange follows principal of Interest Rate Parity in Long Term. Yield of 10 year Government Securities of India is at 7.75% and US Government Securities is at 1.75 %. Hence as per economics INR is likely to depreciate by 6% (7.75% – 1.75%). INR / USD Exchange Rate as on 26th Feb 2016 is 68.62. Hence the rate should be taken as  $68.62 * 1 + (6\%/2) = \text{Rs. } 70.68$ .

2.3. HINDUSTAN POWER commented USO exchange rate may be taken as average of last six months from the date of final Order.

2.4. GREEN ENERGY ASSOCIATION commented that the exchange rate will change as per the purchasing power parity (in other words difference in inflation) of the two countries. Considering the same exchange rate of past 6 months will defy the fundamental academics. The forward rates upto end of next financial year are readily available and shall be the basis considering the exchange rate. Thus as per prudent economic principle this exchange rate should be considered for the calculation purpose. The forward exchange as on 10-01-2016 upto march 2017 is readily available. The average of the same is 69.25 which is also proposed by the applicant to be considered.

2.5. NSL RENEWABLES commented that the Commission adopted the F/E rate of Rs.64.58 per USD on the basis of average RBI rate for the period May-Oct, 2015 but did not mention how this average will be indicative price for 2016-17. Further, given the global market conditions, it is widely believed that there would be further devaluation of Indian Rupee. The exchange rate considered to determine cost of modules is very aggressive and that a



higher exchange rate needs to be considered to estimate the module purchase costs more reasonably.

2.6. SPDA has stated that dollar to INR exchange rate considered by CERC is Rs.64.85/\$, whereas today it is 67 which has been increasing rapidly and expected to reach at Rs.70/\$. When the future expected price of module is considered in benchmark cost then why the future expected price of dollar was not considered in the benchmark cost.

2.7. SUNEDISON ENERGY INDIA LTD, Adani Green Energy Ltd, SUZLON, SPDA and TATA POWER SOLAR, NSEFI have suggested that currency future market data from NSE be taken as the basis for determination of benchmark exchange rates for future procurement for the following reasons:

1. NSE currency market is used by most of institutions/corporate for hedging purposes to manage their currency risk.
2. Most of the procurement activity will happen from the period commencing September 2016 after the financial closure timelines of bids happening today.

Since most of the procurement (including those for JNNSM Phase-II and various ongoing state bids) is going to commence from September, 2016, it is suggested that the exchange rate for USD/ INR be taken as Rs. 69.5.

### **Analysis and Decision**

**Stakeholders have pointed out that Indian Rupee has been depreciating for the past several months. Several companies such as Suzlon, Tata Solar, Adani and Solar Power Developer Association have suggested that currency future market data from NSE be used for arriving at the exchange rate assumption for 2016-17. While the Commission appreciates the currency risk in the current global scenario, the same cannot be ascertained in advance. Average exchange rate for the most recent six months can be considered. For September 2015 to February 2016, the average exchange rate was 66.59 INR/USD, as per RBI website, which is closer to the prevalent exchange rate. The Commission decides to use this exchange rate for the benchmark cost model.**

### **3. Module Degradation**

#### Commission's Proposal

The Commission has considered module degradation as of about 0.6%, which gives a module degradation cost of Rs 9.89 lakhs/MW.

#### Comments Received

3.1. SUNEDISON ENERGY INDIA LTD and NSEFI have requested to factor the annual degradation for Solar PV by accounting for reducing the PLF every year instead of providing an additional Capex. It needs to be noted here that technically the impact of degradation is reduction in PLF and therefore the methodology for calculating the benefit of degradation.

3.2. WELSPUN commented that the annual degradation rate should be 0.80%.

3.3. NSL RENEWABLES commented this amount needs to be enhanced considering the observed degradation of modules in the market which is further impacted by a portion (0.3%) of modules getting damaged every year due to operational and natural causes.

3.4. TATA POWER SOLAR suggests that PV modules used in grid connected solar power plants and from Tier-1 manufacturers have a warranty for output wattage, which is not less than 90% at the end of 10 years and 80% at the end of 25 years which is a linear degradation of 0.7% per annum. CERC is requested to take this into account for the deduction of solar FIT for 2016-17. Also, Hon'ble Commission is requested that the annual degradation for Solar PV should be factored by way of reducing the PLF every year instead providing an additional Capex because of difficulty in determination of costs of future replacements and degradation of additional modules considered every year for the subsequent years. In capex terms this translates to an impact of Rs. 50 lakhs/ MW.

3.5. Adani Green Energy Ltd suggests module degradation to be 0.8%.

3.6. SPDA has commented that prescribed degradation at a rate of 0.6% p.a. is not reflective of the market scenarios as the performance warranties extended by most Module Manufacturers is 20% over 25 years, annual degradation which comes around 0.80%.

### Analysis and Decision

The Commission acknowledges the suggestion from SunEdison, NSEFI and Tata Solar regarding incorporating degradation of modules in reduced PLF of the modules. However, since PLF is already fixed at an average value of 19% for solar PV projects (and 23% for solar thermal projects) for this control period, the Commission has sought to compensate the developers with additional capital cost. A degradation of 0.5% is assumed on a yearly basis, which is then applied to module cost to arrive at yearly degradation cost, followed by discounting to arrive at the net present value of this degradation cost at Rs.8.77 lakhs/MW.

## **4. Land**

### Commission's Proposal

It is proposed that land cost be retained at Rs. 25 lakhs/MW.

### Comments Received

4.1 Association of Power Producers (APP) cited the respective state governments have been notifying the increase in rates for Land Acquisition for the Industry Purpose. Thus it should be taken into consideration and the cost of land should at least be considered at 0.40 Cr per MW.

4.2 OPG commented the cost variation in different states has not been addressed.

4.3 SUZLON commented land cost and per MW area required is justified as per the draft order. However, In the case of solar parks where land is leased the upfront cost is quite high including annual lease rental, which should be incorporated for future references.

4.4 HINDUSTAN POWER requested land cost as at least Rs. 1.20 Crore/MW

4.5 SUNEDISON ENERGY INDIA LTD and NSEFI requested to consider the proposed land cost and revise it to INR 6 Lakh/Acre. They also seek provision of high land requirement for advanced technologies such as tracker etc. and higher land cost in states like Punjab and Maharashtra etc.

## Analysis and Decision

It is understood that land costs vary from state to state and based on the particular location of the projects. However, it must be noted that typically land deployed for these projects is barren in nature. Additionally, land cost has been stagnant over the last financial year. Thus, the Commission retains the land cost at Rs. 25 lakhs/MW.

## **5. Civil & General works**

### Commission's Proposal

Civil and general works cost is proposed to be set to INR 35 lakhs/MW

### Comments Received

5.1 Association of Power Producers suggested the proposed decrease in Cost of Civil works may not be appropriate as the Cost of Civil works have not fallen so drastically. It is therefore request for the cost to be maintained at least at FY 14-15 levels i.e. @ Rs.0.50 Cr/MW.

5.2 HINDUSTAN POWER commented civil costs to be Rs 100 Lakhs/MW at least.

5.3 As per NHPC MOU signed with Govt of Kerala, Civil and General works cost is expected to be Rs 281.60 Lakhs per MW.

5.4 GREEN ENERGY ASSOCIATION suggested that cost varies from site to site and every site is different. With the increase in the capacity the installations are now even done on the highly variable contoured land as well as other typical lands like ash burnt land, marshy land and deserts. Hence it is submitted that it should be kept as previous order.

5.5 WELSPUN commented that civil and general works can be Rs. 45 Lacs/MW.

5.6 According to Ujaas Energy, Civil & Energy work comprises of the average of CPI, Cement & steel. The price for the same shall be last year's price  $\pm$  movement in the same which translates to remain the same as Rs. 50 lakhs/MW as there is no significant variation.

5.7 TATA POWER SOLAR has suggested following break up of Civil works

a) Boundary wall (precast wall with concertina) - 6 lakh/MW

b) Site levelling & Geotechnical Investigation - 3.5 lakh/MW

c) Control room & Inverter room – 9.5 lakh/MW

- d) Approach road (bitumen type), Internal & peripheral road (WBM Type), Drains (Precast type) – 5.5 lakh/MW
- e) Boring, Module Cleaning system RO Plant – 2.8 lakh/MW
- f) Trenching – 3.5 lakh/MW
- g) Earthing – 5 lakh/MW
- h) Misc civil works (culverts, arrangement for prevention of soil erosion, Security hut, Watch tower, Gates)- 4.2 lakh/MW

It is proposed to be at least 40 lakhs/MW.

5.8 OPG POWER GENERATION PVT LTD, SPDA and SUZLON suggested that following aspects need to be considered while defining Civil and General costs:-

-Ground Soil Condition (Bearing Capacity) – Presence of black cotton soil in western & southern parts of the country which is unsuitable due to heavy water retaining capacity requires foundation systems with a cost of more than Rs. 50-60 Lacs/MW. Whereas rocky project sites in central & southern parts of the country requires drilling and anchoring costing Rs. 45-50 Lacs/MW.

- General Contour of virgin ground - General contour of virgin soil will require ground leveling and it is a significant cost component in most projects which increased the cost by around Rs. 5-10 lacs / MW.

-Ground Water Table –A lower level requires heavier design of foundation for both module and buildings. This adds to civil cost of the projects.

-Presence of aggressive chemicals, salt in weather (in Civil Engineering terms “Severe Exposure Condition”) - Presence of salt in air/soil requires special treatment of concrete as well as more Zinc thickness in steel structure to make it durable. Again, the cost will vary based on site exposure.

-Availability of basic raw material for civil works - Depending on all these basic inputs cost of civil component will vary beyond standard assumptions.

-Basic input price of major material like steel and cement - Price of cement varies time to time and can't be benchmarked uniformly. Reinforcing steel cost has changed from INR 35k to INR 43k (basic price) in last one year and it will be difficult to predict future trend.

-Fuel price for construction equipment and tools - Construction tools and equipments are a major component of civil costs (around 18-20%). In this cost, fuel cost is around 30% - 50% at times. This gets impacted due to constant increase in fuel price. Therefore, CERC need to consider this impact and no past price should be taken as benchmark, but it should be linked to market price.

-Availability of skilled labour and contractors - Skilled labour like mason, carpenter, welder, bar binder, fitter etc at a price ranging from Rs. 400/- to Rs. 600/- per day while the minimum wages set by Government for such skilled labour do not exceed Rs 275-300/- per day. Clearly, skilled labour is in short supply for such activities making overall cost higher. Manpower cost is around 12-15% of civil cost.

-Access and logistics for movement of material and equipment to site – Inaccessible sites add to overall cost of logistics and access.

Based on above inputs, it is suggested that the following costs should be taken: as Rs. 45-50 Lacs/MW. Considering the same aspects, NSEFI has suggested Rs. 50 Lakh/ MW as civil and general work cost.

### **Analysis and Decision**

**Several stakeholders have commented that the cost of civil works depends on the quality of soil, ground water table, contour of ground, etc. Tata Solar has given a suggested split of cost components. The Commission has taken all these cost components into account. However, it should be noted that this cost is on a per MW basis, and as plant size increases to 5-10 MW, the costs of control/inverter room, boundary wall, approach road, lighting, etc. get distributed over a larger base. It is neither feasible nor prudent to account for special ground or soil conditions in a generic tariff order. Similarly, NHPC has shared cost details of civil works of installation of floating module structure, which is expected to be much higher due to specialized nature of work and conditions. Nevertheless, special cases can be treated on a project-to-project basis.**

**Civil works include preparation of terrain for digging, levelling and mounting, building control room to house inverter and other BoS components, building approach roads,**

fencing or boundary wall, cable trenching, arranging water supply, lighting etc. General works include security of solar farm, setting up of power back-up generator; yard lighting, earthing kits, etc.

The Commission decides to retain cost of civil works at Rs. 35 lakhs/MW.

## **6. Mounting Structures**

### Commission's Proposal

Mounting structure cost may be set to around INR 35 lakhs/MW

### Comments Received

6.1 Association of Power Producers has stated that the cost for the Mounting structures for the FY 2016-17 is proposed to be Rs.0.35 Cr/MW. The Mounting Structures have been considered for Poly-Crystalline modules (and generalized for other technologies) and not specific to thin film modules. We request the cost of the Structures to be maintained at the levels of FY 2015-16 i.e. @ Rs. 0.50 cr/ MW in order to factor in the extra cost that a developer incurs while using thin film technology which is considered superior to Poly-Crystalline in terms of efficiency.

6.2 OPG and SUZLON commented that requirement of structure varies from 70 MT/MW to 100 MT/MW depending on wind speed as well as type of modules. Therefore cost of structure can vary from Rs. 50 Lacs/MW to Rs. 70 Lacs/MW depending on location etc.

6.3 OPG commented cost towards fixing of structure has not been considered.

6.4 HINDUSTAN POWER requested that there has been significant increase in iron, steel and other necessary materials so the cost towards mounting structures may kindly be considered at least as Rs. 115/MW.

6.5 NHPC informed that as per its MOU with Govt. of Kerala where a solar power project of 50MW is under planning, estimated cost of mounting structures is Rs 50 Lakh per MW

6.6 WELSPUN suggested total Mounting Structure Cost should be Rs 45 lacs/MW.

6.7 SUNEDISON ENERGY INDIA LTD and NSEFI suggest cost of Module Mounting Structure to be Rs. 60 Lacs/MW.

6.8 According to SUZLON, this steel tonnage per MW is justified for specific geographic and land conditions but taking costing based on different geographical areas we need to average the cost as per various aspects involved in civil works as well.

6.9 TATA POWER SOLAR commented the cost of mounting structure with foundation and installation should be around 60 lakhs/MW.

6.10 UJAAS Energy submitted that the WPI index data for steel was considered but the same is neutral. Moreover there is marginal reduction in cost of Zinc which is very low percentage of the overall cost of the structure. There is no technology improvement or material shift for the module mounting structure hence there is no logic to move from the previous years rate i.e. Rs. 50 Lakhs.

6.11 SPDA has commented that basic wind speed varies from 33 m/s to 55 m/s in India. We have implemented projects in all conditions requiring heavier design of structure against uplift and other conditions. The requirement of structure varies from 50 MT/MW to 70 MT/MW depending on wind speed as well as type of modules. Therefore cost of structure can vary from Rs. 40 Lacs/MW to Rs. 50 Lacs/MW depending on location etc.

### **Analysis and Decision**

**SPDA, Suzlon and OPG have stated that depending on wind speeds, amount of steel used will vary from 50 MT/MW to 70 to 100 MT/MW. This is a rather wide range of amount of material needed. The Commission feels that 40-45 MT of steel per MW is a good benchmark assumption for the amount of steel used in mounting structures, if based on cold rolled coil. For very strong wind conditions, one can assume 50 MT/MW at the high end of the spectrum. If based on hot rolled coil, the weight of the structure might be slightly higher. Price of hot or cold rolled coil as raw material for the c-channel may be assumed to be Rs. 41,500/ton on average\*, with an additional cost for galvanization and channel preparation. Price of finished structure may be assumed to be around Rs.60,000-70,000/ton. Thus, the cost of mounting structures, assuming 50 tons/MW, is determined to be Rs.35 lakhs/MW.**

**The Commission retains the cost of mounting structures at Rs.35 lakhs/MW.**

*\* Source: [http://www.sail.co.in/sites/default/files/buyers\\_notice/bilingual\\_eng\\_2.pdf](http://www.sail.co.in/sites/default/files/buyers_notice/bilingual_eng_2.pdf)*



## **7. Power Conditioning Unit (PCU)**

### Commission's Proposal

It is proposed that inverter cost be set to INR 30 lakhs

### Comments Received

7.1 Association of Power Producers have proposed the cost for the Power Conditioning Unit ("PCU") for the FY 16-17 to be Rs.0.30 Cr/MW. We request the Hon'ble Commission to also notify / clarify on the size of the inverter/PCU as per which the proposed cost is determined to ensure / comment on sufficiency of such costs in the present day.

7.2 NHPC informed that as per its MOU with Govt. of Kerala where a solar power project of 50 MW is under planning, cost of PCU is estimated at Rs 45 Lakh per MW.

7.3 SUNEDISON ENERGY INDIA LTD and NSEFI are in agreement with the Commission that the Inverters from reputed manufacturers are available in the range of Rs. 30-35 lakhs/MW. Reason for a higher benchmark is that most of the inverter needs a major overhaul/ replacement in 12th to 14th year of operation. However, Manufacturers are giving extended warranty charging hefty amount at regular interval. Thus, Commission is requested to confirm the same from the Inverter manufacturers. Considering the same, it is suggested that Inverter cost should be kept at INR 40 Lakhs per MW.

7.4 Suzlon commented inverter cost of Rs 30 Lakh/MW is justified. Inverter part replacement is required at least once during lifetime of the project which may cost around 20-30% of the inverter cost. Any other unforeseen costs are part of Contingency. It is requested to consider the known additional replacement cost. Also, manufacturers are giving extended warranty charging hefty amount at regular interval. It is further requested to confirm the same from the Inverter manufacturers. It is suggested that Inverter cost should be kept at INR 40 Lakhs per MW.

### Analysis and Decision

**SunEdison, NSEFI and Suzlon have supported the cost assumption for good quality inverters. However, they have commented that additional cost of replacement of inverter parts or upgrade of inverter at 12-14 years should be considered. The Commission**

acknowledges this and thus includes additional Rs. 5 lakhs/MW for requisite replacement or upgrade. The PCU cost is thereby set to Rs. 35 lakhs/MW.

## **8. Evacuation cost upto interconnection point (Cables & Transformers)**

### Commission's Proposal

It is proposed to consider cabling & transformer costs at INR 40 lakhs/MW.

### Comments Received

8.1. APP has recommended that cost for evacuation be considered separately for different voltage levels. It is also suggested that the Hon'ble Commission notifies a separate per CKM based cost along with it so that in case of any plant specific increase or decrease in the cost of the transmission line is automatically adjusted for. At the very least, this is requested to be kept same as that.

8.2. HINDUSTAN POWER commented Evacuation Cost up to Inter-connection Point {Cables & Transformers} may be considered at least Rs. 111 Lakh/MW.

8.3. NHPC informed that as per its MOU with Govt. of Kerala where a solar power project of 50MW is Rs 55 Lakh per MW.

8.4. UJAAS ENERGY submitted that it should also be based on the PV of transformer for the last year. The reduction in transformer price from April to November 2015 is 8.11% Hence the price of the same should be last years price  $\pm$  movement in the same which translates Rates to:  $Rs. 55 - 55*8\% = 50.6$ .

8.5. GREEN ENERGY ASSOCIATION has submitted that while considering the price of the solar PV inverters has not considered the cost of the mandatory components and accessories associated with it like the Negative Grounding kits Junction boxes, combiner boxes, monitoring systems etc. which has additional cost. Further with the mandatory regulation of scheduling and forecasting additional and appropriate monitoring and forecasting system and setups are required for any of the solar PV power plant which is an additional cost and must be considered. Thus it is submitted that the cost considered by should not be disturbed for inverters and other mandatory components and accessories plus additional 5 Lakhs should be given for the scheduling and forecasting tools and

systems.

8.6. SUNEDISON ENERGY INDIA LTD and NSEFI suggested additional evacuation cost up to interconnection point beyond project switch yard should be considered, as most projects are situated in remote areas and the STU/CTU sub-stations are far off from the Project location. Therefore, additional costs of Rs 20 - 40 Lakh/MW may please be included to provide for the Transmission line, its ROW, Sub-station extension works etc.

8.7. NSL RENEWABLES are of the view that most of the State Commissions and STUs demand that the Transmission lines from the Pooling Sub-Stations of generators to the Grid Sub-Stations of STU be established at the cost of RE generators, in violation of the provisions of Sec 61 (a) of the Electricity Act 2003. Thus the principles and methodologies specified by the Hon'ble Commission are not helpful to the projects as due to this anomaly, the evacuation costs increase significantly (owing to need to construct HT lines). Thus, it is requested that the Hon'ble Commission increase the capital cost assumed for evacuation infrastructure to accommodate this additional requirement.

8.8. WELSPUN suggested that this should be Rs. 55 lakhs/ MW be taken.

8.9. As per SUNEDISON ENERGY INDIA LTD, NSEFI, TATA POWER SOLAR, The following costs also need to be considered:

- Earthing system for DC Plant
- Early Lightning protection.
- Illumination requirements
- Plant internal SCADA & FO cabling.
- Telemetry system for real time data monitoring by SLDC under RRF Mechanism.
- Transmission Line & switchyard for various voltage levels.
- Remote end bay extension + Metering requirement.
- Module Cleaning/Washing system.
- Water sourcing & system cost.
- Water conditioning system.

Additionally, TPS suggested following aspects to be considered as well :-

CCTV, Auxiliary power system arrangement, Cable trays and conduits

It is suggested that a cost of Rs. 60 lakhs/ MW be considered.

8.10. SPDA has disagreed with the Commission on evacuation cost of Rs. 40 Lakhs/MW.

Even the basic cost of cables and transformers would be approx 50 lakhs/MW as below:

- a) DC cables @ 15 Lakh/MW
- b) String Combiner box's/Junction Box's/SCADA @ 10 Lakh/MW
- c) AC Cables/Transformers @ 25Lakh Rs./MW

It may be further noted, that below mentioned costs have not been considered

- a) Transmission cost for a typical 20MW project with an Evacuation at 66KV substation having a distance of 7~8 KM from project site would be 1.5 to 2.0 Cr. Therefore a cost of around Rs. 8~10 Lakh /MW should also be included.
- b) Telemetry system for real time data monitoring by SLDC under RRF Mechanism d. Remote end bay extension + Metering requirement.
- c) Module Cleaning/Washing system.
- d) Water sourcing & system cost.
- e) Water conditioning system. (to maintain water PH to prevent module top cover glass deteriorate)

Considering all of the above, it is suggested that a cost of Rs. 55 lakhs/ MW be taken against the envisaged Rs. 40 lakhs/ MW.

### **Analysis and Decision**

**The following costs are included by the Commission under this heading: cost of transformers and all DC and AC cabling within the solar farm, including DC cabling between solar PV panels and inverters, junction boxes, AC cabling between inverter and pooling station, earthing; LT & HT switchgear, step-up transformer, breakers, isolators, protection relays, CT, PT, and metering.**

**The following cost components suggested by Sunedison, NSEFI, SPDA and Tata Solar are actually accounted for under 'Civil Works': Illumination requirements, Module Cleaning/Washing system, Water sourcing & system cost, Water conditioning system.**

Additionally, given the critical role played by telemetry, the Commission accepts the suggestion to include cost of SCADA systems. This cost may be pegged as ~Rs.4-5 lakhs/MW.

Cost of forecasting and scheduling services is very minimal on per MW and monthly basis.

It is clarified that this cost component includes costs of evacuation only up to the interconnection point, as defined in the RE Tariff Regulations:

*“ 2.(n) ‘Inter-connection Point’ shall mean interface point of renewable energy generating facility with the transmission system or distribution system, as the case may be:*

*i. in relation to wind energy and Solar Photovoltaic Projects, inter-connection point shall be line isolator on outgoing feeder on HV side of the pooling sub-station; “*

While a few stakeholders have mentioned that the developers have to construct overhead transmission lines to the nearest grid sub-station, this cost is beyond the scope of RE Regulations, and may be considered on a project-to-project basis by the procurer.

The total cost for evacuation is hereby set to Rs. 44 lakhs/MW.

## **9. Preliminary & Pre operative expenses**

### Commission's Proposal

Detailed breakup of Preliminary and Pre-operative expenses and financing cost, lump sum in percentage of total capital cost is proposed as under:

- i. Insurance Cost and Contingency: 0.5% -1%
- ii. Interest during Construction (IDC): 3-4%
- iii. Financing cost: 1%
- iv. Project management cost: 0.5%
- v. Pre-operative Cost: 0.5%

Preliminary/Pre-operating expenses and Financing Cost contribute to around 5%-7% of total capital cost on average basis. Accordingly, these expenses are suggested at 5.5% of total capital cost, or Rs. 26.13 lakhs/MW.

### Comments Received

9.1. APP suggest that Preliminary and Pre-operative expenses would not reduce so exponentially and it is therefore requested to be maintained at least at the levels of FY 2015-16 or a decrease of 10%

9.2. NHPC informed that as per its MOU with Govt. of Kerala where a solar power project of 50 MW is being planned, preliminary costs are assumed to be Rs 55 Lakh per MW.

9.3. HINDUSTAN POWER suggested under different heads for determining capital cost for Solar PV project at least 10% may be considered as Preliminary and Pre-Operative Expenses including IDC and Contingency expenses.

9.4. WELSPUN commented total Preliminary/Pre-operating expenses and Financing Costs must be average 6.5%

9.5. RML Renewables commented that unplanned costs are incurred during project execution for local infrastructural development, social development/CSR and other contingencies including right of way issues. Further, investment for replacement of invertors as provided is not sufficient. Thus, it is suggested that contingencies/other expenses be increased and at least 7~8% of the cost be provided instead of 5.5%.

9.6. UJAAS ENERGY submitted same shall be kept at 8% as considered in the last order.

9.7. SUZLON requested review of the standard cost practices for the project life and also incorporating DPR preparation cost to arrive at a real figure. It is suggested that the Preliminary/Pre-operating expenses, Financing and Contingency Costs may be considered as 8-10% of the corresponding project cost. Break up as under:

a. Financing cost needs to be considered at 2% of debt fund,

b. Project management cost should be considered at 1.5-2% of project cost and

c. IDC at 8% instead of 4% considered by the Commission.

d. In addition contingency is higher due to local factors, higher transportation cost on remote locations. Considering the same proposed norms should be reconsidered.

Also, other Charges like in the State like Rajasthan there is a grid connectivity charge of Rs. 2 Lakhs/MW and the State Nodal Agency is also charging Rs. One Lakhs/MW/annum as development charges as per State Policy. These recurring charges in the states should also be considered.

9.8. TATA POWER SOLAR suggested that the following costs be modified as follows:

- Insurance Cost and Contingency: - Contingency should be in the range of 2%
- Project management cost: -Project management cost is in the range of 2.5% depending on the scale and location..
- Additional costs towards logistic cost is approx 1.5%;
- Taxes and Duties in the range of 1% -2% depending on the taxes as per central and state policy.

So it is suggested that these expenses be taken at least at 9% as noted by Hon'ble CERC in the paper instead of 5.5% as envisaged.

9.9. SUNEDISON ENERGY INDIA LTD and NSEFI recommend that the Preliminary/Pre-operating expenses and Financing Costs may be considered as 10% of the corresponding project cost. Financing cost needs to be considered at 2% of debt fund, project management cost should be considered at 1.5-2% of project cost and IDC at 8% instead of 4% considered by the Commission. Contingency is higher due to local factors, higher transportation cost on remote locations. Other Charges like in the State like Rajasthan there is a grid connectivity charge of Rs. 2 Lakhs/MW and the State Nodal Agency is also charging Rs. 10 Lakhs/MW as development charges as per State Policy. Moreover, a provision of labour cost that will be incurred by the developer should be considered at Rs. 10 Lakhs/MW. It is also suggested that following other costs need to be considered:

- Almost 3% of module needs to be replaced every year for which approximate cost is 1.5% of the cost of project;
- In addition, cost of transmission line from pooling sub-station to nearest grid sub-station is a range from INR 20 lakhs to 50 lakhs per MW depending upon the size of the project

9.10. SPDA has commented that as per the past experience and trend in solar industry, Preliminary/Pre-operating expenses and Financing Costs may be considered as:

- Insurance cost and contingency: 1.0%-1.5%
- Interest during Construction (IDC): 3%-4%
- Financing cost & Project management cost: 1.5%-2.0%
- Pre-operative Cost: 0.5%
- Project Management Cost: 1.0%-1.5%

The total Preliminary/Pre-operating expenses and Financing Costs should be considered @ average 6.5%

## **Analysis and Decision**

SunEdison and NSEFI have mentioned module replacement and transmission line in their comments. It is clarified that module replacement costs are included as 'degradation' cost under module cost, whereas cost of transmission line is not included as per definition of inter-connection point in the Regulations.

Secondly, several stakeholders have commented that IDC should be increased. However, Commission is of the view that due to the short construction period, IDC of 3% is commensurate. Specifically, highest capital cost is of panels which are installed towards the end of project lifecycle.

Tata Power Solar has mentioned that Taxes and Duties are in the range of 1% -2% depending on the taxes as per central and state policy. It is clarified that additional taxes and duties are pass-through in tariff on actual incurred basis, as per Regulation 23 of RE Tariff Regulations.

SunEdison and Suzlon have mentioned that state specific charges should be included. However, in determining a generic tariff, state specific charges cannot be accounted for.

Regarding right-of-way (ROW) costs, these are applicable only if transmission lines are laid beyond the inter-connection point. As clarified in a previous section, evacuation costs only up to the inter-connection point (pooling sub-station) are included; thus, ROW costs are beyond the scope of generic tariff calculations.

## **10. Miscellaneous**

### **Comments Received**

10.1. NHPC suggested there must be standardized norms available for finalization of capital cost / tariff of floating Solar PV Power projects. This will also promote the installation of Solar PV Projects in the unused marshy lands / water bodies

10.2. OPG POWER GENERATION PVT LTD requested following aspects to be considered in order

-the complete scope of supply and work of EPC.

-The SCADA, Weather monitoring station, Communication equipment etc. -The Installation and commissioning cost has been ignored altogether



-Differentiation between the AC and DC capacity. The hon'ble Commission may consider issuing solar orders on DC capacity basis

-The quoted tariff trends seen in tenders concluded for mega projects recently are result of participation of foreign funds in the process. Servicing of domestic funds is much costly.

-the complete Bill of Material in the Order, to eliminate error in scope of supply and services.

-The variation in civil scope across the regions

10.3. GREEN ENERGY ASSOCIATION commented that the tariff of 4.63 has been discovered in a project which is of a magnitude of 500MW and 350 MW in one single location. Further the bid doesn't restrict for the procurement of domestic modules and there is further advantage of the magnitude of the size of the project. The second bid of 350 MW where the similar tariff was discovered is won by the world's leading financial institution soft bank which has its own mandate to invest in renewable energy in India with very low interest rates. The project is a private investment for power sale and not governed by the strict specifications of any government entity PSU as in other bids conducted by PSUs and SECI etc. The projects are yet to kick start and practicality and rationality of these tariffs are yet to be established. The tariff has been discovered in an installation in a SOLAR PARK. The scope of work in the said bids is entirely different / limited as compared to the scope of work in other normal solar PV project in the country, price of \$0.48/W. It is further requested to consider impact of prices of solar pvmodules of different category viz. Imported modules, Domestic modules with imported cells and Domestic modules with domestic cells.

### **Analysis and Decision**

**OPG and SunEdison have referred to the lower cost of funds for foreign companies that might be a factor in the low bids that have been discovered in recent tenders. This is understandable; however, the Commission in its tariff calculation has considered cost of capital in India, and the debt/equity norms currently prevalent in the country. While financial norms are already provided in the Regulations, the Commission cannot be oblivious to market realities. Each cost component has been analysed in detail, and the Commission has taken an informed decision based on the best possible information available.**

Incorporating a bill of materials as suggested by OPG is beyond the scope of this order. Other points raised by OPG such as DC/AC capacity and SCADA costs are addressed in previous sections.

## 11. Overall Capital Cost

### Commission's Proposal

S.No.	Particulars	Capital Cost norm proposed for FY 2016-17 (Rs. lakhs/MW), for Solar PV projects	% of Total Cost
1	PV Modules	310.19	61.9%
2	Land Cost	25	5%
3	Civil and General Works	35	7%
4	Mounting Structures	35	7%
5	Power Conditioning Unit	30	6%
6	Evacuation Cost up to Inter-connection Point (Cables and Transformers)	40	8%
7	Preliminary and Pre-Operative Expenses including IDC and Contingency	26.13	5.2%
	<b>Total Capital Cost</b>	<b>501.32</b>	<b>100%</b>

### Comments Received

11.1. NHPC suggested following as per MOU with Govt of Kerala

SI No.	Particulars	Capital cost proposed	% of total cost
1	PV Modules	332.35	38.91%
2	Land cost	0 (arranged by Kerala Govt.)	0%
3	Civil & General works	281.60	32.96%
4	Mounting Structures	50	5.85%
5	Power Conditioning unit	45	5.27%

6	Evacuation cost upto interconnection point (Cables & Transformers)	55	6.44%
7	Preliminary and Preoperative expenses including IDC and contingency	86.31	10.10%
8	Miscellaneous and unforeseen Expenditure	4	0.47%
9	Total Capital Cost	854.26	100%

11.2. According to WELSPUN, the overall capital cost break out is as follows:-

S.No.	Particulars	Capital Cost Norms for FY	
		2016-17 Lakh. Rs./MW	% of Total Cost
	PV Modules	338.13	60.44%
	Land Cost	25	4.47%
	Civil and General Works	45	6.26%
	Mounting Structures	45	6.26%
	Power Conditioning unit	30	5.36%
	Evacuation Cost (including transmission)	55	10.72%
	Preliminary and Pre-Operative Expenses including IDC and Contingency	37.50	6.50%
		575.63	

11.3. According to TATA, overall capital cost break out is as follows:-

S.No.	Particulars	Suggested norms Rs. Lakhs per MW
1	PV Modules	331.2
2	Land Cost	25
3	Civil and General Works	40
4	Mounting Structures	60
5	Power Conditioning Unit	30
6	Evacuation Cost up to Interconnection Point (Cables and Transformers)	60
7	Preliminary and Pre-Operative Expenses including IDC and Contingency	49
	Total Capital Cost	595.2

11.4. According to SUZLON, overall capital cost break out is as follows:-

No.	Particulars	Capital Cost proposed by Suzlon (Rs c Lakhs)	% of Total Cost
1	PV Modules	340	55.74%
2	Land cost	31	5.08%
3	Civil and General Works	50	8.2%
4	Mounting Structures	50	8.2%
5	Power Conditioning Unit	39	6.38%
6	Evacuation Cost upto Interconnection Point (Cables and Transformers)	50	8.2%
7	Preliminary and Pre – Operative Expenses including IDC and Contingency	50	8.2%
	Total Capital Cost	610	100%

11.5. According to SunEdison and NSEFI, the overall capital cost of Solar Photo voltaic power projects for the FY2016-17 as INR 575 Lakhs/MW as benchmark project cost of Solar PV projects.

11.6. According to Ujaas Energy Ltd, the total PV cost should be as follows :-

Sr. No.	Particulars	Rs. in Lacs
1	Cost of Modules	378
2	Non Module Cost Component	253
	Total	631

11.7. According to SPDA, total solar PV cost should be as follows:-

S.No.	Particulars	Capital Cost Norms for FY 2016-17Lakh. Rs./MW	% of Total Cost
1	PV Modules	338.13	60.44%
2	Land Cost	25	4.47%
3	Civil and General Works	45	6.26%
4	Mounting Structures	45	6.26%

S.No.	Particulars	Capital Cost Norms for FY 2016-17 Lakh. Rs./MW	% of Total Cost
5	Power Conditioning unit	30	5.36%
6	Evacuation Cost (including transmission)	55	10.72%
7	Preliminary and Pre-Operative Expenses including IDC and Contingency.	37.50	6.50%
	<b>Total</b>	<b>575.63</b>	

### Analysis and Decision

As analysed in the previous sections, the Commission accepts the following changes to the parameters:

- a) Exchange rate to be taken as average over most recent six months
- b) Module prices to be taken as \$0.48/W
- c) PCU cost to be taken as Rs.35 lakhs/MW
- d) Evacuation cost to include cost of SCADA/telemetry, and now taken as Rs. 44 lakhs/MW

Thus, the benchmark capital cost norm for Solar PV projects for FY 2016-17 shall be INR 530.02 lakhs/MW, with breakup as follows:

S.No.	Particulars	Capital Cost norm proposed for FY 2016-17 (Rs. lakhs/MW), for Solar PV projects	% of Total Cost
1	PV Modules	328.39	61.96%
2	Land Cost	25	4.7%
3	Civil and General Works	35	6.6%
4	Mounting Structures	35	6.6%
5	Power Conditioning Unit	35	6.6%
6	Evacuation Cost up to Inter-connection Point (Cables and Transformers)	44	8.3%
7	Preliminary and Pre-Operative Expenses including IDC and Contingency	27.63	5.21%
	<b>Total Capital Cost</b>	<b>530.02</b>	<b>100%</b>

## SOLAR THERMAL

### Commission's Proposal

The Commission proposes to retain benchmark capital cost of Solar Thermal power projects at INR 12.0 Crore / MW for FY 2016-17.

### Comments Received

a. Association of Power Producers (APP) commented the "per MW" cost "as calculated by the Commission" should be Rs 13.77. In order for FY 2014-15. The drop in DNI has its impact on the CUF and in order to keep the CUF same at 23%, the solar field size needs to be enhanced requiring additional capital cost. However the per MW capital cost should be arrived at by using the denominator of 50 MW instead of 55.55 MW, which should have been used to take care of the additional cap ex required to maintain CUF of 23%. Thus the "as determined per MW capital cost" of the Hon'ble Commission should be Rs 688.57 Cr /50 MW, i.e. Rs 13.77 Cr /MW.

b. APP has further commented that the Capital cost considered by the Hon'ble Commission for FY 2016-17 at Rs 12 Cr/MW (which should have been calculated to be Rs 13.77 Cr/MW as explained above) is not in line with the break up considered for Solar PV capital cost and does not include Preliminary, Pre-operative and Evacuation cost up to the interconnection point. Considering all the factors as detailed below in order to bring about uniformity in the benchmarking of capital cost break up of Solar PV and Solar

- Exchange rate of —Rs 65/USD should be considered.
- On similar basis the Hon'ble Commission should consider Preliminary, and Pre-Operative cost including IDC and Contingency to the tune of 10% of Project Cost
- Evacuation Costs of Rs 20 Lakh/MW up to the Interconnection point beyond plant boundary should also be considered.

Taking all the above into account, the capex per MW be increased to Rs 18.59 Cr per MW.

- Water system cost should be 5% of the total cost.
- The land cost considered may be revised to Rs. 10 Lakh/MW to reflect the current market price.

- Township Cost: Due to remoteness of locations suitable for Solar Thermal project development, a township of Rs 25 Lakh

Taking all the above into account, the capex per MW be increased to Rs 18.59 Cr per MW.

### **Analysis and Decision**

Given the nascent stage of technology for Solar Thermal, the Commission has proposed to retain the benchmark cost without any decrease. At this point, it is not feasible to further increase these prices. The Commission decides to retain the benchmark capital cost for Solar Thermal power projects at INR 12.0 Crores / MW for FY 2016-17.

Sd/-  
**( M.K.Iyer)**  
**Member**

Sd/-  
**(A.S. Bakshi)**  
**Member**

Sd/-  
**(A.K. Singhal)**  
**Member**

Sd/-  
**(Gireesh B. Pradhan)**  
**Chairperson**