

**CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI**

Petition No. 255/2010 (*suo-motu*)

Coram: Dr. Pramod Deo, Chairperson
Shri S. Jayaraman, Member
Shri V.S. Verma, Member
Shri M. Deena Dayalan, Member

Date of hearing: 19.10.2010

Date of Order: 09th November, 2010

In the matter of

Determination of Benchmark capital cost norm for Solar PV power projects and Solar Thermal power projects applicable during FY 2011-12

ORDER

1. The Commission has notified the Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2009 (hereinafter "the RE Tariff Regulations") on 16.09.2009. The first proviso of Regulation 5 of the RE Tariff Regulations provides that the Commission may annually review the benchmark capital cost norm for Solar PV and Solar Thermal power projects.
2. The Benchmark capital cost norms as stipulated under Regulation 57(1) for Solar PV power project and under Regulation 61(1) for Solar Thermal power project are applicable for solar power projects to be commissioned during FY 2009-10 (i.e. upto 31.03.2010).
3. Subsequently, as per Regulation 5 of the RE Tariff Regulations, Commission had reviewed, vide Order dated 25.02.2010 (in Petition no. 13/2010 suo-motu) and fixed the benchmark capital cost for Solar PV power projects at ₹1690 Lakh/MW for the FY 2010-11. Further as per the first amendment to RE Tariff Regulations (vide notification No.L-7/186(201)/2009-CERC dated 25.02.2010), the generic tariff determined for solar PV power projects based on the benchmark capital cost and other norms applicable for 2010-11 shall also be applicable for such projects commissioned during 2011-12 subject to the condition that the Power Purchase Agreement (PPA) is signed on or before 31.03.2011 and entire capacity covered under the PPA is commissioned on or before 31.03.2012.

4. In the above referred Order, the Commission had also reviewed and fixed the benchmark capital cost for Solar Thermal power projects at ₹ 1530 Lakh/MW for the FY 2010-11. Further, as per the first amendment to the RE Tariff Regulations (vide notification No.L-7/186(201)/2009-CERC dated 25.02.2010), the generic tariff determined for Solar Thermal power projects based on the benchmark capital cost and other norms applicable for 2010-11 shall also be applicable for such projects commissioned during 2011-12 and 2012-13 subject to the condition that the PPA is signed on or before 31.03.2011 and entire capacity covered under the PPA is commissioned on or before 31.03.2013.
5. In exercise of the power under the Regulation 5 of the RE Tariff Regulations, the Commission vide Order dated 15.09.2010, proposed to determine the Benchmark Capital cost norm for Solar PV power projects and Solar Thermal power projects for the year 2011-12 (Petition No. 255/2010 - Suo-Motu) for inviting comments/suggestion/objections from the stakeholders.
6. The Commission invited comments from the various stakeholders vide its public notice no. (Petition No. 255-256/2010 (Suo-Motu) Dated 17.09.2010. Last date of submission was kept on 10.10.2010. In response to the same written comments/suggestions received from following stakeholders:
 1. M/s Azure Power
 2. M/s Rudraksh Energy, Rajasthan
 3. M/s Bloomberg New Energy Finance
 4. M/s Suryachakra Power Venture Pvt. Ltd.
 5. M/s Reliance Power Ltd.
 6. M/s Abengoa Solar
 7. M/s Tata BP Solar
 8. M/s ACME
 9. Assam Electricity Regulatory Commission (AERC)
7. Subsequently, a public hearing was held on 19.10.2010 and following stakeholders expressed their views/suggestions/comments in person:
 1. M/s Abengoa Solar
 2. M/s ACME
 3. M/s Tata BP Solar
 4. M/s Chhattisgarh Biomass Energy Developers Association (CBEDA)

8. The Commission analysed the views/comments/suggestions of the stakeholders and the Commission's decisions are as below;

Solar PV Power Projects

A. Land Cost

Comments

Land Costs norm should be ₹ 5 Lakh/acre including conversion charges and legal fee expenses. (M/s Azure Power)

Analysis and Decision

The benchmark capital cost norm for solar PV and solar thermal projects is a generic norm representing overall scenario in the country. Generally the land acquired for setting up solar power projects are mostly arid/barren or of no commercial use. The Commission would like to reiterate its earlier observation that with the development in technology, the solar to electricity conversion efficiency shall improve, which will eventually translate to reduction in requirement of land per MW of installation. Therefore, the Commission has decided to retain the land cost norm of ₹ 3 lakh / acre as proposed.

B. Civil & General Works

Comments

The cost of civil and general Works proposed by the Commission at ₹ 0.95 crore per MW. It is based on 6% of the total project cost. Estimate of civil and general works must be costed on individual line items and actual cost should be taken as ₹ 1.23 cr. /MW. (M/s Azure Power)

Analysis and Decision

The Commission while proposing the ₹ 0.90 crore/MW as expenditure towards civil and general works had taken into consideration the submission made by the developers in their detailed project report submitted to State Electricity Regulatory Commission for determining project specific tariff. The Commission has considered the cost escalation of 5% over the last year's cost and proposed to consider 0.95 Crore/MW as the cost for Civil and General work for benchmark capital cost of Solar PV projects for FY2011-12, which seems to be reasonable. The escalation of 5% is based on the escalation of Iron and Steel and Electrical Machinery indices over the last quarter. Share (in %) of each component in the total capital cost is a derivation and not a basis of arriving at the cost of each such component.

C. Power Conditioning Unit (PCU)

Comments

PCU cost of ₹ 1.6 crore /MW is not realistic. Cost of inverters, transformers, erection & installation of HT yard and other equipments for PE are ₹ 2 crore per MW. (M/s Azure Power)

Analysis and Decision

For the MW scale projects, the EPC contractors are reportedly offering EPC cost which (including cost of grid inverters) at ₹ 1.6 Crore/MW or less. As far as cost of transformers and installation of the HT yard, the Commission has separately proposed ₹ 0.90 Crore/MW to be considered as expenditure towards DC cabling between Solar PV panels & Inverters including junction boxes, AC cabling between Inverter & sub-station, Earthing arrangements and Transformer including the EPC cost of a step up outdoor type transformer, breaker, Current Transformers, Potential Transformers, Isolators, LAs, protection relay and TOD meter for determining the benchmark capital cost for Solar PV projects for the year 2011-12.

D. Financial Cost

Comments

The Commission has proposed financial cost at ₹ 14.42 Lakh per MW which is understated. It should be considered at ₹ 96 Lakh /MW which include facility fee of 1% of loan amount i.e. ₹ 10 Lakh/MW and expenses towards 6 months debt service as collateral i.e. ₹ 86 lakh/MW as. (M/s Azure Power)

Analysis and Decision

Not all project finance transactions have requirements for a Debt Service Reserve Account (DSRA). The purpose of a DSRA is to provide a cash buffer during periods where Cash Available for Debt Service is less than the scheduled payments. Solar project developer should satisfy a lender to consider its expected earnings from that project as the source of funds from which a loan would be repaid and the assets of the project can be considered as collateral for the loan. Further, many module manufacturers/suppliers are giving generation guarantee so that there should not be an issue of technological risk of such project. Considering above, the Commission has decided the financial cost at ₹ 14.42 Lakh per MW.

E. Capacity Utilization Factor (CUF)

Comments

CERC RE Tariff Regulation specifies CUF of 19%, however, M/s Azure's plant in Punjab commissioned in December 2009 has achieved CUF closure to 17-18%. (M/s Azure Power)

Benchmark CUF of 19% is difficult to achieve in some of the States. (M/s Rudraksh Energy, Rajasthan)

Analysis and Decision

CUF is depends on several factors including the solar radiation, temperature, air velocity apart from the module type and quality, angle of tilt (or tracking), design parameters to avoid cable losses and efficiencies of inverters and transformers. There are some inherent losses which can be reduced through proper designing but not completely avoided. Thin film modules will perform better than the crystalline modules in high temperature zones.

The RE tariff Regulation specifies the CUF for Solar PV project based on the average. The review of the CUF norm, as specified in the RE tariff Regulation, is not the subject matter of present regulatory process which has been initiated for determination of generic tariff for FY 2011-12.

F. Compensation of Degradation

Comments

Some project developer may not add modules after 4th year as envisaged. It appears fundamentally wrong to capitalize the cost of plant that has not been installed and commissioned on COD and in turn allowing RoE (part of which has not been deployed) and interest on loan (part of which has not been drawn). It is proposed to allow additional capitalization only after the plant has been installed, as has been the usual practice along with the O & M charges subject to the condition that payment shall be allowed only after the additional modules have been installed and commissioned. (M/s Rudraksh Energy, Rajasthan)

Degradation of max.0.5%/year from 4th year of deployment, but suppliers is willing to warranty only 10 years which is far more than the 0.5% /year. (M/s Reliance Power Ltd.)

Analysis and Decision

It is to be noted that the RE Tariff Regulation does not specify degradation factor for any kind of renewable energy technology. However, based on the suggestion received from the stakeholders, the Commission has considered reasonable compensation for degradation due to ageing while determining generic tariff for FY 2011-12. An additional 0.5 % of the modules cost every year after 4th year has been allowed on notional basis.

Normally manufacturers provide a guarantee with a definite margin of safety and for design purpose; therefore, a lower degradation percentage can be employed. The quality of module is of immense importance. Therefore, it is safe to assume no degradation for the first three years and then a maximum of 0.5% per year over the life of modules. Further, it is found that the length of warranty period is continuously increasing, indicating the increase in confidence among manufacturers, as they realize durable quality of their products, due to technology improvements and quality assurance practices.

G. Solar PV Capital Cost

Comments

The weekly retail price should be considered instead of spot market trend as it is highly fluctuating. In order to promote Indian make crystalline PV module the cost of module should be taken as \$2/watt, this implies that the total module cost should be ₹ 9.56Cr/MW including degradation impact. The total capital cost may be taken as ₹ 15.775Cr/MW. (Tata BP Solar)

The realistic cost of solar PV plant may be estimated at ₹ 18 crore /MW for the State of Assam. (AERC)

There might be drop in the prices of most of the modules but such cut will discourage the project developer. Price reduction shall maintain at a gradual level instead of ending it at steep curve. (Reliance Power Ltd.)

Our forecasts of future crystalline silicon PV module prices based on the experience curve and expectations of global PV Capacities going to build in the next few year, we believe that in 2011 module prices on the global market will be significantly lower than the \$1.75/watt anticipated in the Explanatory Memorandum for Benchmark Capital Costs by the Commission. Further, the short term historical prices are no guide to future prices and will turn out to be over-generous tariff, resulting in greater than expected cost to consumers and governments. Near-term expected costs for utility-scale (1MW+) PV systems in \$/W would be as under (Bloomberg New Energy Finance)

	2010	2011	2012	2013
Module	1.72	1.33	1.07	0.94
Inverter	0.28	0.26	0.25	0.24
Balance of plant	0.47	0.45	0.43	0.41
Engineering, procurement and construction	0.45	0.43	0.41	0.39
Other (development and arrangement fees, contingency)	0.32	0.29	0.28	0.27
Total system cost	3.24	2.77	2.44	2.24

Analysis and Decision

According to M/s Bloomberg New Energy Finance’s study on crystalline module experience curve, the module cost is significantly lower than the norm proposed by the Commission and based on the cost of tracking systems for PV modules, cables, or engineering expertise estimated from 2009 and 2010 best-in-class values for utility-scale projects the total capital cost of the solar PV power project worked out is between 12.93 Cr. to 11.4 crore per MW for the FY 2011-12.

Since, we are determining bench mark capital cost for very near future i.e. FY 2011-12, we can’t totally ignore the fluctuation in the recent module price trend which reflects the prevailing demand and supply scenario in the market. The Commission has balanced the interest of investors and consumers while deciding this benchmark capital cost.

Solar Thermal power Projects

A. Applicability of Tariff of Solar Thermal Projects in the FY 2011-12

Comments

Request has been made to clarify determination of benchmark capital cost norm 2011-12 as in the earlier Order it is stated that the tariff determined for FY 2010-11 shall be applicable for FY 2011-12 and 2012-13. Further, it has been submitted that such frequent revision of benchmark capital cost and further lowering of the tariff poses difficulties to the developers to make the projects viable and achieve financial closure and therefore

objector has requested to retain the earlier benchmark capital cost and tariff for Concentrated Solar Power (CSP). (M/s Suryachakra Power Venture Pvt. Ltd.)

Analysis and Decision

In accordance with the Regulation 5 of the RE Tariff Regulations, the benchmark capital cost for Solar PV and Solar thermal require to be reviewed annually by the Commission. This yearly review is necessary for reflecting the true project cost based on the dynamics of solar power project development.

Further, In accordance with the RE Tariff Regulation (first amendment), in respect of Solar Thermal power projects, whose PPA is signed on or before 31.03.2011 and the entire capacity going to be commissioned on or before March 31, 2013, the tariff determined by the Commission for the year FY 10-11 shall be applicable during the FY 2011-12 and FY 2012-13. Such levellised tariff determined would be applicable for the entire tariff period of the project.

For those projects, whose PPAs are to be signed after March 31, 2011, the tariff would be based on the benchmark capital cost norm for Solar PV and solar thermal projects for the FY 2011-12.

B. Solar Renewable Purchase Obligation (RPO)

Comments

The Commission should consider the interchangeability of Solar RPO with the non-solar RPO. The ratio may be kept as 1:4 (1 Solar: 4 non-solar) and such a provision may be kept for initial 3 years till project under development get commissioned. (M/s Reliance Power)

Analysis and Decision

Specifying RPO is the responsibility of the SERCs.

C. Capital cost of Solar thermal project

Comments

There is not enough experience available in Solar Thermal Projects. The proposed cost of Concentrated Solar Power (CSP) is ₹ 15Cr/MW for FY 2011-12 where the cost taken for the FY 2010-11 is ₹ 15.3Cr/MW. Due to non-availability of know-how, limited knowledge and solar irradiation & equipments the benchmark return of equity for the project seems quite inadequate. (Reliance Power Ltd.)

Project cost should be considered at 5.0 million US\$/MW for Solar Thermal power project based on parabolic trough and based on the same tariff should be at least ₹ 15/KWh plus annual inflation should be considered. (Abengoa Solar)

The Commission's Explanatory Memorandum referred ACME's submission before RERC on project cost of ₹ 14.94 Cr/ MW. It is to be clarified that this figure was based on our initial estimates and actual cost for our ongoing project in Rajasthan is around ₹ 15.97 Cr/ MW. It is also requested to consider the impact of Customs duty in the feed-in-tariff calculation for the FY 2010-11. (ACME)

Project cost was simply considered as ranging from ₹ 26.67Cr to ₹ 51Cr. It is requested to note that the lowest mentioned costs of ₹ 16.67 Crore is in the location where radiation was highest. Therefore, in India, where the radiation is lower, the project cost will be higher. The project cost should be around ₹ 20 Crore/MW. Further submitted that Indigenization has been mentioned for achieving cost reductions, but it will take time for the development of the local industry, therefore, the capital costs cannot come down before 2013-14 and till the local industry matures. (Suryachakra Power Venture Pvt. Ltd.)

The proposed capital costs for solar thermal project is close to our own estimates for best-in-class systems today. It is possible that by using locally-sourced components and a low cost of capital, Indian Solar project developers of these technologies can achieve the costs so far estimated. (Bloomberg New Energy Finance)

Analysis and Decision

The Commission, while proposing the project cost at ₹ 15 Crore/MW, has considered the different technologies available in the Solar Thermal power project category, the data submitted by the project developer to Rajasthan Electricity Regulatory Commission (RERC), indigenization of balance of system including power block, structures and lower labour cost prevailing in India. The capital cost for Solar Thermal power plants (without storage facilities) which is under development and to be commissioned by 2012 in the developed countries, have been reported around US \$ 3.4/ W (equiv. ₹ 15.87 Crore/MW). The Commission is of the view that it can be reduced further upto 15 Crore/MW with indigenization of balance of system including power block and structures along with lower labour cost prevailing in India. Considering the same, the Commission decided not to make drastic reduction in the benchmark capital cost of solar thermal project for the FY 2011-12 for determination of tariff. Moreover, solar power projects are able to get finance at lower interest rates, considering that the overall project cost as proposed seems reasonable.

9. Considering the above, the Commission hereby determines Benchmark Capital cost norm for Solar PV power projects for the year 2011-12 at ₹ 14.42 Crore per MW and Benchmark Capital cost norm for Solar Thermal power projects for the year 2011-12 at ₹ 15 Crore per MW.

10. It is important to note that the Tariff for Solar PV power projects and Solar Thermal power projects whose PPA to be signed after 31st March 2011, shall be based upon these Benchmark Capital cost norms and other parameters in accordance with stipulations under the RE Tariff Regulations.

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