



**TARIFF ORDER
FOR
ROOFTOP SOLAR PLANTS IN MANIPUR
FOR
FY 2019-20**

Petition No. 4 of 2019

**JOINT ELECTRICITY REGULATORY COMMISSION
FOR THE STATES OF MANIPUR & MIZORAM**

Tariff Order for Roof Top Solar Plants in Manipur

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ABBREVIATIONS

BoQ	Bill of Quantities
CAPEX	Capital Expenditure
CARE	Credit Analysis and Research Ltd
CEI	Chief Electrical Inspector
CERC	Central Electricity Regulatory Commission
CFA	Central Financial Assistance
CUF	Capital Utilization Factor
DPE	Department of Public Enterprises
DNI	Direct Normal Irradiance
DT	Distribution Transformers
EPD	Empanelled Project Developers
GHI	Global horizontal Irradiance
IEC	International Electro technical Commission
IPDS	Integrated Power Development Scheme
IT	Income Tax
JERC	Joint Electricity Regulatory Commission for Manipur & Mizoram
kWh	Kilo Watt Hour
kW	Kilo Watt
LLPs	Limited Liability Partnerships
MW	Mega Watt
MNRE	Ministry of New and Renewable Commission Energy
MOUD	Ministry of Urban Development
MSW	Municipal Solid Waste
NABARD	National Bank for Agriculture & Rural Development
NABL	National Accreditation Board for Testing and Calibration laboratories
NDCS	Nationally Determined Contribution
NSM	National Solar Mission
O&M	Operation & Maintenance
PAC	Project Appraisal Committee
PMC	Project Management Consultancy
PSU	Public Sector undertaking
PT	Power Transformer
MSPDCL	MANIPUR State power Distribution Company Limited
RDF	Refuse Derived Fuel
RE	Renewable Energy
RoE	Return on Equity
RTs	Rooftop Solar
RTPV	Rooftop Photovoltaic
RBI	Reserve bank of India
RESCOs	Renewable Energy Service Companies
SPV	Solar Photovoltaic
SERC	State Electricity Regulatory Commission
SNA	State Nodal Agency for Renewable Energy
SEG	Solar Energy Group
SECI	Solar Energy Corporation of India
SBBR	State Bank Base Rate
SMERA	SME Rating Agency of India Ltd
SRRA	Solar Radiation Resources Assessment
SPIN	Solar Photovoltaic Installation
SSI	Small Scale Industries
UT	Union Territory
MANIREDA	Manipur Renewable Energy Development Agency

JOINT ELECTRICITY REGULATORY COMMISSION FOR MANIPUR AND MIZORAM

**TBL Bhawan, 2nd to 5th Floor, Peter's Street,
E-18, Khatla Aizawl-796001, Mizoram**

Petition No. 4 of 2019

In the matter of

Determination of Tariff for Rooftop Solar Plants in Manipur for FY 2019-20

And

Manipur Renewable Energy Development Agency (hereinafter referred to as "MANIREDA")

Present

**Mr. LALCHHARLIANA PACHUAU
Chairperson**

**Mr. NGANGOM SARAT SINGH
Member**

ORDER

1. Background

The Manipur Renewable Energy Development Agency (here in after referred to as "MANIREDA" or Petitioner has filed Petition on 20.02.2019, under Section 62 and Section 86 (i) of Electricity Act, 2003 read with Section 8 of Joint Electricity Regulatory Commission for Manipur and Mizoram (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2010 dated 31.05.2010 and the Joint Electricity Regulatory Commission for Manipur and Mizoram (Terms and Conditions for Tariff determination from Renewable Energy Sources) (First Amendment Regulation, 2014) dated 08.08.2014 for determination of tariff for Solar Roof Top Plants of capacity 1 kW to 1000 kW.

The Commission on preliminary analysis admitted the Petition on 29.01.2019.

2. Manipur Grid Interactive Rooftop Solar Photo-voltaic (SPV) Power Policy 2014

Government of Manipur has notified “Manipur Grid Interactive Rooftop Solar Photovoltaic (SPV) Power Policy 2014” according to which the eligible consumers of the distribution licensee, who are having sufficient space on the rooftop of their buildings, shall be entitled to install solar rooftop projects either under gross metering arrangements or net metering arrangement.

Provided that eligible consumers availing net metering shall not be allowed to apply for gross metering within the same premises.

Third party is also eligible for installation of rooftop power plants by entering into a lease agreement with the consumer of the premises.

3. Applicable Subsidy

The Ministry of New and Renewable Energy (MNRE) GOI is providing Central Financial Assistance (CFA) up to 30% of benchmark cost for all types of residential buildings for General categories states and up to 70% for North Eastern states. Similar CFA is also available for schools, health institutions including municipal colleges and hospitals, universities educational institutions and other social sectors such as welfare homes, NGOs, training institutions, orphanages, etc.

No CFA is applicable for Govt./PSU buildings, Govt. institutions, private / commercial / industrial buildings. However, MNRE provides achievement linked CFA for Government/PSU buildings, Government institutions, Private/Commercial/ Industrial buildings.

4. Capacity of Solar Rooftop project

The eligible consumers / third party shall install project of minimum capacity of 1 kW up to a maximum of 500 kW with/without battery backup support.

5. Metering system

All the equipment to be installed like solar PV panels, inverters, synchronizers, MPPT, batteries, transformers, cables, junction boxes, etc. shall be as per specified Indian / IEC standards. MSPDCL shall install / seal tested bi-directional (export/import) or separate export and import energy meters for all solar PV projects. The same could be purchased by plant owner or provided by MSPDCL at pre-notified rates. **The meters should be as per CEA and BIS specifications only. Installation of Solar rooftop projects shall be carried out as per the JERC for Manipur and Mizoram**

(Metering for Grid Connected Renewable Energy) Regulations, 2016 and its amendments.

6. Manipur Renewable Energy Development Agency

Accordingly, MANIREDA published the tariff petition in an abridged form as public notice in the following newspapers besides placing the tariff petition on the MANIREDA website inviting objections/ suggestions from public and stake holders/ consumers.

7. Commission Order determining Tariff for Solar projects

The Commission issued the order dated 05.01.2015 for determination of generic levelised generation tariff for various renewable energy sources including Solar PV for FY 2014-15 under Regulation-8 of JERC (Terms and Conditions for Tariff Determination from Renewable Energy Sources) Regulations, 2010 dated 31.05.2010 and first amendment vide Regulation, 2014 dated 05.08.2014. The Commission again issued the Order dated 2.11.2016 and Review Order dated 02.11.2017 for solar rooftop levelised tariff in Manipur. The Regulations mentioned above provide for terms and conditions and the procedure including various technical norms for determination of tariff for various categories of Renewable Energy Generating Stations including Solar Photo-Voltaic.

8. Current Petition of MANIREDA

Since the tariff determined by the Commission in its order dated 2nd January, 2017 is applicable for a period of one year, MANIREDA has filed the current petition for determination of tariff for 1 kW to 500 kW roof top solar PV projects.

9. Admission of the Current Petition

Under the circumstances explained by MANIREDA the Commission admitted the Petition for determination of generic tariff for 1 KW to 500 KW solar rooftop projects and directed the MANIREDA to publish its application in an abridged form to ensure public participation.

10. Public Hearing Process

Accordingly, MANIREDA published the tariff petition in an abridged form as Public notice, inviting objections/suggestions from its stakeholder in the following newspapers.

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Sl. No	Name of the Newspaper	Language	Date of Publication
1	Poknapham	Manipuri	31 st January 2019
2	Sanghai Express	English	31 st January 2019

The interested parties/stakeholders were asked to file their objections/suggestions within ten (10) days from the date of publication of the notice.

The Commission to ensure transparency in the process of tariff determination and for providing proper opportunity to all stake-holders/ consumers and general public for making suggestions/ objections on the tariff petition has decided to hold a public hearing at the headquarters of the state.

Accordingly, the Commission has published a notice in the following leading newspapers giving due intimation to the general public, interested parties and the consumers about the public hearing that will be held in Hotel Classic Regency Hall, Imphal on 06.03.2019 from 11.00 A.M to 12.30 P.M

Sl. No	Name of NEWS paper	Language	Date of Publication
1	POKNAPHAM	MANIPUR	19 th & 20 th February 2019
2	IMPHAL FREE PRESS	ENGLISH	26 th & 27 th February 2019

The public hearing was held on 06.03.2019 as scheduled. During public hearing each objector was provided time for presenting his/ her views on the tariff petition of MANIREDA before the Honourable Commission.

The names of those who filed their objections and the objectors who participated in the public hearing for presenting their objections are given in **Annexure -I**.

A short note on the main issues raised by the objectors in their written submissions and also in the public hearing in respect of the Tariff Petition along with response of MANIREDA, reply of MSPDCL and the Commission's Views on the responses are briefly narrated in **Chapter – 3**.

11. Order

In exercise of the power vested under section 62 read with section 64 of the E. Act 2013 and Regulation 8 of JERC (M&M) (Terms and Conditions for Tariff Determination from Renewable Energy Sources), Regulations 2010 and other enabling provisions in this behalf the Commission issues the order for determining

generic tariff for solar roof top projects of capacity of 1 kW to 10kW, above 10kW to 100 kW, above 100kW to 500 kW in the State of Manipur.

12. Contents of the Order

This order is divided into four Chapters as detailed below:

The **First Chapter** provides Introduction, JERC for Manipur and Mizoram (JERC for M & M).

The **Second Chapter** provides summary of MANIREDA Petition

The **Third Chapter** provides Brief account of Public Hearing Process, including objections raised by Stakeholders, response of MANIREDA, reply of MSPDCL and Commission's views on the same.

The **Fourth Chapter** provides Analysis of the Petition and determination of generic tariff for solar roof top installations of capacity 1 kW to 500 kW.

13. The MANIREDA should ensure implementation of the order from the effective date on issuance of a public notice in such font size which is clearly visible in two daily newspapers having wide circulation in the state within a week and compliance of the same shall be submitted to the Commission.
14. This order shall be effective with immediate effect and shall remain in force for one Gregorian Calendar year or till next Rooftop Solar tariff order is issued by the Commission, whichever is earlier.



(NGANGOM SARAT SINGH)
Member



(LALCHHARLIANA PACHUAU)
Chairperson

Place: Aizawl
Date: 04.04.2019

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CHAPTER 1: Introduction

1. JERC for Manipur and Mizoram (JERC, M&M)

In exercise of the powers conferred by the Electricity Act 2003, (hereinafter referred to as Act) the Government of India constituted Electricity Regulatory Commission for the States of Manipur and Mizoram to be known as “Joint Electricity Regulatory Commission for Manipur and Mizoram” vide GOI. Gazette (Extra Ordinary) Notification No. 23/3/2002 R&R dated 18/01/2005, (hereinafter referred to as Commission) as per the authorization given by the Government of Manipur and the Government of Mizoram vide Memorandum of Agreement dated 23/07/2004. The Commission constituted is a two-member body designated to function as an autonomous authority responsible for regulation of the power sector in States of Manipur and Mizoram. The powers and functions of the Commission are as prescribed in the Act. The head office of the Commission is presently located at Aizawl, the capital town of Mizoram. The Commission became functional w.e.f January 24th, 2008.

- a) In accordance with the Act, the Commission discharges the following functions:
- i. Determine the tariff for generation, transmission, distribution and wheeling of electricity, wholesale, bulk or retail, as the case may be, within the State: Provided that where open access has been permitted to a category of consumers under Section 42 of the Act, the State Commission shall determine only the wheeling charges and surcharge thereon, if any, for the said category of consumers;
 - ii. Regulate electricity purchase and procurement process of distribution licensees including the price at which electricity shall be procured from the generating companies or licensees or from other sources through agreements for purchase of power for distribution and supply within the State;
 - iii. Facilitate intra-State transmission and wheeling of electricity
 - iv. Issue licenses to persons seeking to act as transmission licensees, distribution licensees and electricity traders with respect to their operations within the State;

- v. Promote co-generation 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;
 - vi. Adjudicate upon the disputes between the licensees and generating companies; and to refer any dispute for arbitration;
 - vii. Levy fee for the purposes of this Act;
 - viii. Specify State Grid Code consistent with the Central Grid Code specified under Clause (h) of sub-section (1) of Section 79 of the Act;
 - ix. Specify or enforce standards with respect to quality, continuity and reliability of service by licensees;
 - x. Fix the trading margin in the intra-State trading of electricity, if considered, necessary;
 - xi. Discharge such other functions as may be assigned to it under the Act.
- b) Further, the Commission also advises the State Government on all or any of the following matters namely:
- i. Promotion of competition, efficiency and economy in activities of the electricity industry;
 - ii. Promotion of investment in electricity industry;
 - iii. Reorganization and restructuring of electricity industry in the State;
 - iv. Matters concerning generation, transmission, distribution and trading of electricity or any other matter referred to the State Commission by the State Government.
- c) The State Commission ensures transparency while exercising its powers and in discharging its functions.
- d) In discharge of its functions, the State Commission is guided by the national Tariff Policy (NTP) as brought out by GOI in compliance to Section 3 of the Act. The objectives of the NTP are to:
- Ensure availability of electricity to consumers at reasonable and competitive rates;

- Ensure financial viability of the power sector and attract investments;
- Promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimize perceptions of regulatory risks;
- Promote competition, efficiency in operations and improvement in quality of supply.

2. MANIPUR RENEWABLE ENERGY DEVELOPMENT AGENCY

Manipur Renewable Energy Development agency (MANIREDA) is an autonomous Government Agency under the Department of Power, Government of Manipur setup for promoting renewable energy sources in the State

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CHAPTER 2: Summary of Tariff Proposal for Rooftop solar plants of capacity 1kW to 1000 kW

2.1 Tariff proposal

The MANIREDA has proposed the levelised Tariff for solar rooftop projects of capacity 1 kW to 500 kW as detailed in the Table below:

Table 2.1: Tariff for Solar rooftop projects proposed by MANIREDA

Sl. No.	Particulars	Solar Rooftop project capacities		
		1-10 kW	>10-100kW	>100-500 kW
1	Capital cost /kW	60,000	55,000	53,000
2	Normative CUF	12.62%	12.62%	12.62%
3	Levelized Tariff (Rs/kWh) (without subsidy)	10.21	9.48	8.95
Levelised Tariff for Residential, Institutional and Social sector (Rs/kWh)				
4	70% subsidy	4.13	3.91	3.82
Levelized Tariff for Government Institutions (Rs/kWh) based on achievement				
5	60% subsidy	5.00	4.71	4.59
6	36% subsidy	7.08	6.62	6.43
7	24% subsidy	8.13	7.58	7.36

The worksheet for the above assumed Tariff is as detailed in the Table below:

Table 2.2: Technical Parameters (for 1kW-10kW)

1	Capacity of the Power Project.	1-10 kW	kW
2	Capacity Utilization Factor (For the first year)	12.62%	%
3	Capacity Utilization Factor (From second year onwards)	12.62%	%
4	Annual Gross Generation (For the first year)	1105.51	kWh/kW
5	Annual Gross Generation (From second year onwards)	1105.51	kWh/kW
6	Auxiliary consumption	0.00%	%
7	Annual Net Generation (For the first year)	1105.51	kWh/kW
8	Annual Net Generation (From second year onwards)	1105.51	kWh/kW
9	Annual Deration	0.00%	%
10	Life of Plant and Machinery / Project Life	25	years

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Table2.3: Financial Parameters (for 1kW-10kW)

1	Capital Cost of Power Project	60	Rs Thousand
2	Non - Depreciable Amount / Salvage value	10.00%	% of Capital Cost
3	Depreciable Amount (Cap Cost Less non-depreciable Cost)	54	Rs Thousand
4	Debt Fraction	70.00%	%
5	Debt	42	Rs Thousand
6	Equity	18	Rs Thousand
7	TOTAL (Debt+Equity)	60	Rs Thousand
8	Interest Rate on Term Loan	11.83%	%
9	Repayment Period	12	years
10	Moratorium Period	0	years
11	Term loan period for principal payment	12	years
12	Depreciation for First 12 years(Straight Line Method)	5.83%	% p.a.
13	Depreciation for Next 13 years(Straight Line Method)	1.54%	% p.a.
14	Discount Rate	13.08%	%
15	O&M cost	1.537	Rs. Thousand
16	O&M Cost Escalation	5.72%	% p.a.
17	Insurance Cost	0.00%	%
18	Return on Equity (1-10 years)	20.00%	%
19	Return on Equity (11-20 years)	24.00%	%
20	Minimum Alternative Tax (First 10 years)	21.34%	%
21	Corporate Tax (Last 10 years)	34.61%	%
22	Interest on working capital	12.33%	%
23	MNRE Subsidy/ CFA	70%,60%,36%,24%	% of Capital Cost

Table 2.4: Technical Parameters (for >10kW- 100kW)

1	Capacity of the Power Project.	>10 kW-100kW	kW
2	Capacity Utilization Factor (For the first year)	12.62%	%
3	Capacity Utilization Factor (From second year onwards)	12.62%	%
4	Annual Gross Generation (For the first year)	1105.51	kWh/kW
5	Annual Gross Generation (From second year onwards)	1105.51	kWh/kW
6	Auxiliary consumption	0.00%	%
7	Annual Net Generation (For the first year)	1105.51	kWh/kW
8	Annual Net Generation (From second year onwards)	1105.51	kWh/kW
9	Annual Deration	0.00%	%
10	Life of Plant and Machinery / Project Life	25	years

Table2.5: Financial Parameters (for>10kW-100kW)

1	Capital Cost of Power Project	56.00	Rs Thousand
2	Non - Depreciable Amount / Salvage value	10.00%	% of Capital Cost
3	Depreciable Amount (Cap Cost Less non-depreciable Cost)	50.40	Rs Thousand
4	Debt Fraction	70.00%	%
5	Debt	39.20	Rs Thousand

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6	Equity	16.80	Rs Thousand
7	TOTAL (Debt+Equity)	56.00	Rs Thousand
8	Interest Rate on Term Loan	11.83%	%
9	Repayment Period	12	years
10	Moratorium Period	0	years
11	Term loan period for principal payment	12	years
12	Depreciation for First 12 years(Straight Line Method)	5.83%	% p.a.
13	Depreciation for Next 13 years(Straight Line Method)	1.54%	% p.a.
14	Discount Rate	13.08%	%
15	O&M cost	1.537	Rs. Thousand
16	O&M Cost Escalation	5.72%	% p.a.
17	Insurance Cost	0.00%	%
18	Return on Equity (1-10 years)	20.00%	%
19	Return on Equity (11-20 years)	24.00%	%
20	Minimum Alternative Tax (First 10 years)	21.34%	%
21	Corporate Tax (Last 10 years)	34.61%	%
22	Interest on working capital	12.33%	%
23	MNRE Subsidy / CFA	70%,60%, 36%,24%	% of capital cost

Table2.6: Technical Parameters (for>100kW-500kW)

1	Capacity of the Power Project.	>100 kW-500kW	kW
2	Capacity Utilization Factor (For the first year)	12.62%	%
3	Capacity Utilization Factor (From second year onwards)	12.62%	%
4	Annual Gross Generation (For the first year)	1105.51	kWh/kW
5	Annual Gross Generation (From second year onwards)	1105.51	kWh/kW
6	Auxiliary consumption	0.00%	%
7	Annual Net Generation (For the first year)	1105.51	kWh/kW
8	Annual Net Generation (From second year onwards)	1105.51	kWh/kW
9	Annual Deration	0.00%	%
10	Life of Plant and Machinery / Project Life	25	years

Table 2.7: Financial Parameters (for >100kW-500kW)

1	Capital Cost of Power Project	53.00	Rs Thousand
2	Non - Depreciable Amount / Salvage value	10.00%	% of Capital Cost
3	Depreciable Amount (Cap Cost Less non-depreciable Cost)	47.70	Rs Thousand
4	Debt Fraction	70.00%	%
5	Debt	37.10	Rs Thousand
6	Equity	15.90	Rs Thousand
7	TOTAL (Debt+Equity)	53.00	Rs Thousand
8	Interest Rate on Term Loan	11.83%	%
9	Repayment Period	12	years
10	Moratorium Period	0	years
11	Term loan period for principal payment	12	years
12	Depreciation for First 12 years(Straight Line Method)	5.83%	% p.a.
13	Depreciation for Next 13 years(Straight Line Method)	1.54%	% p.a.
14	Discount Rate	13.08%	%
15	O&M cost	1.537	Rs. Thousand
16	O&M Cost Escalation	5.72%	% p.a.
17	Insurance Cost	0.00%	%

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18	Return on Equity (1-10 years)	20.00%	%
19	Return on Equity (11-20 years)	24.00%	%
20	Minimum Alternative Tax (First 10 years)	21.34%	%
21	Corporate Tax (Last 10 years)	34.61%	%
22	Interest on working capital	11.50%	%
23	MNRE Subsidy / CFA	70%,60%,36%,24%	% of capital cost

Table: 2.8: Proposed Tariff for Solar Roof top Projects during FY 2019-20

Sl. No.	Particulars	Solar Rooftop project capacities		
		1kW-10kW	10kW-100kW	100kW-500kW
1	Capital Cost/kW	60,000	55,000	53,000
2	Normative CUF	12.62%	12.62%	12.62%
3	Levelised Tariff over 25 years (without Subsidy)	10.21	9.48	8.95
Levelised Tariff for Residential, Institutional and Social sector (Rs./kWh)				
4	70% Subsidy	4.13	3.91	3.82
Levelised Tariff for Government Institutions (Rs./kWh) based on achievement				
5	...60% subsidy	5.00	4.71	4.59
6	...36% subsidy	7.08	6.62	6.43
7	...24% subsidy	8.13	7.58	7.36

2.2 Prayer

The petitioner respectfully requests the Hon'ble Commission to:

1. Admit this petition for determination of tariff for grid interactive rooftop solar and small scale solar plant for FY 2019-20.
2. It is further requested that the Hon'ble Commission shall determine feed-in-tariff for rooftop solar and small scale solar plants of size from 1kW to 10kW, > 10kW - 100 kW, > 100kW to 500 kW for FY 2019-20 as per cost-plus methodology as proposed in their petition is tabulated at Table 2.8 above.
3. Condone any inadvertent omission/errors/short comings and permit the petitioner to add/change/modify/alter this filing and make future submissions as may be required at a future date.

CHAPTER 3: Brief outline of objections raised, response of MANIREDA and the Commission's Views

3.1 Introduction

On admitting the petition of MANIREDA for fixation of levelised tariff for solar rooftop power plants, the Commission directed the MANIREDA to make available the copies of petition to general public, post the petition on their website and also publish the same in newspapers in abridged form and invite comments / suggestions / objections from them.

3.2 Public Hearing

In order to ensure transparency in the process of determination of levelized tariff, as envisaged in the electricity act 2003, public hearing was held at Hotel Classic Regency hall, Imphal on 06.03.2019 from 11 AM to 1PM. During the public hearing the participants were given an opportunity to offer their views on the petition filed by MANIREDA for fixation of levelised tariff for solar rooftop plants in Manipur state. The list of stake holders and officers who attended the public hearing is given in **Annexure-I**. the officers of MANIREDA who attended the public hearing have responded on the issues raised by the objectors.

3.3 The details of the objections and responses from MANIREDA Officials are as follows:

Objector 1: Executive Director (Commercial), MSPDCL

Objection-1: Low CUF considered compared to standard of 19% and also average tariff for Solar in rest of India is lower than the tariff proposed by MANIREDA for FY 2019-20.

Objection-2: Purchase of solar power is not of much use as this will only help to meet RPO. For Central sector projects, the quota cannot surrender and in case of no purchase, fixed charges have to pay.

Objection-3: Solar power generators are not taking subsidy and therefore, as per tariff order, DISCOM has to pay higher tariff. Why subsidy has not been taken by the generators?

Replies:

- 1. Regarding CUF:** In the earlier two tariff orders on Grid Connected Rooftop Solar & Small Scale Solar Power Plants (FY 2016-17 & FY 2017-18) passed by Hon'ble JERC-MM, the CUF considered as 19%. This was based on the CERC RE tariff Regulations meant for utility scale grid connected solar projects. For grid connected Rooftop Solar & Small Scale Solar Power Plants, no separate CUF has been mentioned by CERC in their regulations. Over the period of last two tariff orders, the installation of grid connected rooftop solar and small scale solar projects gradually pick up in Manipur and now the actual operational data of such project is available for analysis. The CUF proposed by the petitioner for determination of tariff for FY 2019-20 is based on analysis of actual generation recorded by the operational projects in the state. The CUF analysis is submitted in the petition submitted by MANIREDA. In the analysis presented in the petition actual generation and CUF of those commissioned rooftop solar projects were considered which are in operation from last 12 months or more periods. The Petitioner has considered the CUF of 42 projects out of total 106 projects installed as on October 2018. These projects are operating more than 12 months and therefore considerable generation data is available, which has been used to determine the representative CUF for the State of Manipur. The petitioner while proposing the normative CUF for tariff determination during FY 2019-20 rely on the actual generation data of projects installed in Manipur rather than to take all India normative CUF of 19% which is recommended for utility scale large solar power projects. The petitioner has also considered the unique geographical location of Manipur and solar irradiance, number of sunny days as well as sunshine hours in a year while proposing the normative CUF for FY 2019-20. Apart from this, frequent fluctuation in grid voltage / power failures directly affect inverter performance thereby resulting in less generation.

In view of above facts, the petitioner proposed CUF of 12.62% for tariff determination for FY 2019-20.

- 2. Regarding Low tariff for solar in rest part of India:** Most of the solar tariff discussed in the public hearing, were for utility scale large solar power projects. This is not comparable to the tariff of rooftop solar projects as already discussed in the petition. Most of the projects installed in Manipur are in the range of 1-10kW and are fall under the subsidized category for which the tariff proposed by MANIREDA is in the range Rs. 4.13/kWh, which is reasonable. In comparison, the power purchase cost, as submitted by MSPDCL for FY 2019-20, is (Rs 452.66cr (cost of power purchase) + 61.12cr (inter-

state transmission charge) + 86.57cr (intra-state transmission charge) + 0.71cr (NERLDC charge)) divided by 975.12 MU, i.e, Rs 604.06 Crore /975.12 MU = Rs 6.19/ kWh (as per ARR data submitted by MSPDCL for FY 2019-20).

- 3. Regarding high cost Solar purchase:** The promotion of RE energy is the policy decision of State Government and MANIREDA is bound to follow the policy decision of the Government. MANIREDA has specified a target of 50 MW solar installations up to 2022 (20 MW in net metering and 30 MW in gross metering mode). Corresponding to this, the actual installation to date is just about 2 MW, which is not encouraging. MANIREDA is implementing rooftop solar and small scale solar project program by through the empanelled contractors on annual basis.

Although the RE policy notified by Government of Manipur provides for gross metering and net metering option as per the choice of consumer, most of the consumer prefer net metering option because of rising tariff. In case of net metered solar roof top project the actual injection into the grid will be negligible as most of the generated power shall be use for captive consumption. In general, a consumer draws power from the grid at load factor of 50%-60% and its solar generation would be 12-13. For example, for a 10 kW solar installation actual consumption from grid would be = 10 (contract demand equivalent to capacity of solar project) X 8760 (total hours in a year) X 50% (load factor) = 43800 kWh. However, the generation from a 10 kW solar projects would be = 10 (capacity of solar project) X 8760 (total hours in a year) X 12.62% (load factor) = 11055 kWh; around 25% of the annual consumption indicating that most of the power is consumed by consumer for captive use.

In case of gross metering mode of operation, the DISCOM has to purchase the entire power produced by solar projects at FIT determined by the Commission. As presence of commercial and Industrial consumer is negligible in the state it has been assumed that some residential consumer may prefer gross metering mode of operation. To understand the impact of procurement of solar power on Average Cost of Supply (ACoS) of DISCOM during 2019-20, following exercise is presented.

Impact on Average cost of supply (ACoS) of MSPDCL due to purchase of solar power from rooftop projects

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Assumption

Installed capacity during FY 2019-20	3000 KW
Individual capacity of project	1-10 KW
Mode of operation	Gross metering
Proposed CUF	12.6%
FIT for procurement by MSPDCL	Rs 4.13/kWh (with 70% subsidy)
Annual Revenue Requirement of MSPDCL for FY 2019-20*	Rs 741.49 crore
Total sale of MSPDCL during FY 2019-20*	975.12 MU (including surplus sales)
Average cost of Supply (ACoS) for FY 2019-20*	Rs 7.60 /kWh

*as per tariff filing of MSPDCL for FY 2019-20

Result:

Total solar power generation from the 3000 kW solar roof top projects	$3000 \times 8760 \times 12.6\% = 3.31 \text{ MU.}$
Cost of solar power procurement for MSPDCL	$3.31 \times 4.13 = \text{Rs } 1.37 \text{ crore.}$
Revised ARR cost of MSPDCL for FY 2019-20	$741.49 + 1.37 = \text{Rs } 742.86 \text{ crore.}$
Revised sale of MSPDCL for FY 2019-20	$975.12 + 3.31 = 978.43 \text{ MU}$
Revised ACoS of MSPDCL after consider 3000 kW solar roof top projects	$742.86 / 978.43 = \text{Rs } 7.59 / \text{kWh}$
Per unit impact on ACoS of MSPDCL due to purchase of solar power	$\text{Rs } 7.59 - \text{Rs } 7.60 = - (1\text{paise/kWh})$ ACoS of MSPDCL reduced by 1 paise/kWh

4. **Regarding subsidy being not taken by consumers:** As per data available with MANIREDA, out of 1.21 MW total installations in commercial, domestic, society, institution, hospital etc. as on date, only 35 kW of solar projects are installed without subsidy. Also, as per MNRE guidelines commercial and industrial projects can't avail the capital subsidy. The domestic and social sector can avail subsidy to the extent of 70% as Manipur fall under special category state. Therefore, most of the projects can avail the capital subsidy and MANIREDA is facilitating the project installation continuously.

Objector 2: Mr. Rocky, Manager, MSPDCL

Objection-1: Compared to previous tariff order the Capital Cost for 1-8kW was Rs. 82,500 for which the tariff was Rs. 9.39/kWh (without subsidy) whereas for FY2019-20 the tariff proposed is at Rs. 10.21/kWh (without subsidy) against a capital cost of Rs. 60,000/KW for the range 1-10kW. So, capital cost is decreasing whereas tariff is increasing, what is reason behind this?

Objection-2: In case of justification for low CUF, it was stated that the accumulation of dust on solar panels results in reduction of generation. This should not be a reason that should be extended to the DISCOM. The clearing is the responsibility of the generator and DISCOM should not pay higher tariff for lower UF due the dust accumulation.

Comments:

1. Regarding higher tariff and lower Capital Cost:

It is true that the Capital cost of rooftop and small scale solar power project is decreased from Rs 82,500 to Rs 60,000 from FY 2017-18 to FY 2019-20 for small scale projects in the range of 1-10 KW. The reason for proposed increase in tariff during FY 2019-20 is that the petitioner has requested for normative CUF of 12.62% based on operational project data in the state instead of national average CUF of 19%.

2. Regarding accumulation of Dust on Solar Panels: MANREDA and empanelled firms have an agreement for cleaning of solar panels after every 4 months. Even then especially during the dry season, lot of dust accumulates which results in reduced generation. This fact has just been pointed out as one of the factors for low CUF and not the only primary cause of reduced generation.

Several other objections are come in the course of hearing which was not related to the tariff petition filed by MANIREDA, MANIREDA prefers not to comment on those objections as same are outside the purview of present petition.

The Objection raised by the public and Replies given by MANIREDA during the public hearings are noted by the Commission.

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Chapter 4: Analysis of Capital Cost and Determination of Levelised Tariff for Solar Roof Top Plants

4.1 Analysis and Decisions

The levelised tariff for Rooftop Solar PV Projects is discussed below:

4.2 Capital Cost Petitioner's Submission

Approach for determination of Benchmark Capital Cost for FY 2019-20

- 4.2.1** The Commission in the previous tariff order dated 2.11.2016 acknowledged the petitioner's submission that the capital cost for MW scale solar PV projects cannot apportion to the kW-scale rooftop solar PV plants. The cost of inverters and other equipment in kW scale solar plants is found to be on higher side than the utility scale solar projects. The Commission has also recognized the fact that Manipur is situated at difficult terrain and therefore the transportation cost in Manipur is significantly higher than the national average cost and such cost accounts for 10 to 15 % of the hardware cost.
- 4.2.2** The petitioner in the previous petition, projected component wise capital cost for PV module and balance of system. The Commission also, while fixing the benchmark capital cost in the previous tariff order analysed the component of the capital cost, like the cost of PV modules, invertors, mounting structures, balance of system etc. and approved the capital cost benchmark cost.
- 4.2.3** The petitioner in the present petition for determination of tariff for FY 2019-20 prefer to examine the reduction in the capital cost for rooftop and small solar plants over FY 2016-17 to FY 2018-19 (Q 2) mainly due to decline of the PV module cost in the international market. It has been noted that the cost of Non-Module component/ balance of system is not changed substantially and remain more or less same as approved by the Commission in 02.11.2016 tariff order.
- 4.2.4** The petitioner has examined the PV module cost trends for rooftop and small solar plants during FY 2016-17 to FY 2018-19 under (i) Market Approach (ii) Tender / Competitive bidding approach and compared results with the Benchmark Capital cost for rooftop solar plant specified by MNRE for FY 2018-19. The petitioner in the subsequent paragraph present the analysis of Capital cost in different approaches as

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mentioned above for three categories of rooftop solar PV and small solar plants viz. 1-10 kWp, > 10kWp to 100 kWp and >100kWp to 500 kWp.

Market Approach: Under the market Approach the petitioner analyses the PV module prices and cost trends provided in the leading solar market report /journals available on the internet, which are being referred by the SERCs while deriving for the capital cost benchmark for solar PV plants in India.

(A) MERCOM Capital Group

The Market Intelligence Report (Solar) for Q3 2018 dated 29 October 2018 reports the technology-wise PV module prices in September 2018 with changes over the previous month.

Table 4.1: PV module prices (€/Wp) in September 2018 reported by MERCOM

Overview of the Price Points in September 2018, by Technology, with Changes Over the Previous Month				
Module Class	Price(€/Wp)	Trend Since September 2018	Trend Since January 2018	Description
High Efficiency	0.35	-2.80↓	-27.10↓	Crystalline modules, 285W and above with PERC, HIT, N-type, or back- contact cells or a combination thereof
All Black	0.36	-2.70↓	-23.40↓	Module type with back sheets, black frames and a rated power between 200W and 320 W.
Main Stream	0.27	-6.90↓	-27.00↓	Modules typically with 60 cells, standard aluminum frame, white back sheet and 260-280W, represents the majority of the modules of the market
Low Cost	0.2	-4.80↓	-23.10↓	Factory seconds, insolvency goods, used or low-output modules(Crystalline) products with limited or no warranty

Above table shows the technology - wise PV module cost and its trend from January 2018. It has been noticed that the PV module cost is in declining mode since Jan 2018. The petitioner has considered the Mainstream module class which represent the majority of modules in the market for arriving at the cost of PV module during FY 2018-19. The cost of Mainstream module class is equal to 0.27 € /Wp ~ INR 22,600 /kWp (conversion rate 1€ =INR83.04). By considering PV module cost of Rs 22,600/kWp and assuming the cost of Non- module component (Invertor, mounting structure, Balance of system), transportation and insurance as approved by the commission in the previous tariff order

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dated 2.11.2016, the petitioner has worked out the Capital cost for rooftop solar and small solar plant for FY 2019-20 as given below:

Table 4.2: Capital cost for Rooftop and small solar plant as per Market report (MERCOT)

Particulars	1-10KW	10-100 KW	100-1000 KW
Solar Module	24481.77	23540.16	22600
Inverters	10000	8500	7000
Mounting structure	6000	5500	4500
Balance of system	6000	6000	6000
Installation	5000	5000	5000
Transportation at 15%	6972.265	6531.024	6015
Contingency (3%)	1394.453	1306.2048	1203
*Taxes at 5%	2324.088	2177.008	2005
TOTAL	62172.57	58554.39	54323

*Assumption: the developer /installer shall execute the project on turnkey basis

(B) PV insights

The website PV Insights (pvinsights.com) report the latest solar PV weekly price for PV modules. The market PV module price reported by PV Insights as on 30.10.2018 are provided in the table below:

Table4.3: PV module spot prices (€/Wp) in October 2018 by PV insight

Solar PV Module Weekly Spot Price					
Item	High	Low	Average	Avg Chg	Avg Chg%
Poly Solar Module	0.330	0.200	0.224	↓-0.002	↓--0.88%
Poly Module in China	0.260	0.200	0.212	↓-0.002	↓-0.93%
Poly High Eff/PERC Module	0.370	0.220	0.256	↓-0.002	↓-0.78%
Mony High Eff/PERC Module	0.420	0.240	0.273	↓-0.003	↓-1.09%
Mono High EFF/ PERC Module in China	0.270	0.240	0.251	↓-0.001	↓-0.4%
Thin Film Solar Module	0.350	0.220	0.247	↓-0.003	↓-1.2%

The petitioner has considered the cost of poly silicon Module for arriving the cost of PV module during FY 2018-19. PV module cost equal to 0.33\$ /Wp ~ INR 24,240 /kWp (conversion rate 1 \$ = 73.46 INR). By keeping the non PV module cost unchanged (as approved by the Commission in previous order) the capital cost for rooftop solar and small solar plant can be projected as given below:

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Table 4.4: Capital cost for Rooftop and small solar plant as per Market report (PV insight)

Particulars	1-10KW	10-100 KW	100-1000 KW
Solar Module	26258.32	25248.384	24240
Inverters	10000	8500	7000
Mounting structure	6000	5500	4500
Balance of system	6000	6000	6000
Installation	5000	5000	5000
Transportation at 15%	7238.748	6787.2576	6261
Contingency (3%)	1447.75	1357.45152	1252.2
*Taxes at 5%	2412.91	2262.41	2087
TOTAL	64357.73	60655.51	56340.20

*Assumption: the developer /installer shall execute the project on turnkey basis

i. Capital cost discovered through tender/bidding route.

MANIREDA EoI for empanelment of firms for rooftop solar plant implementation in phase-III (FY 2018-19): MANIREDA has invited Expression of Interest for empanelment of firms for implementation of grid connected rooftop solar power plants in Manipur during FY 2018-19 (third phase) vide EoI No 5/SPP/RT/MANIREDA/2018-19 dated 09.08.2018. Subsequently, vide notice dated 09.10.2018, MANIREDA approved the rates for different capacities of roof top solar projects to be installed in Manipur during FY 2019-20 as given below:

Table4.5: Capital Cost specified by MANIREDA for Solar Roof Top projects for FY2019-20

1-10 KW	>10 KW-100 KW	>100-500 KW
Rs 60,000/KWp	Rs 55,000/kWp	Rs 53,000/kWp

All firms were qualified for implementation of rooftop solar power plants in during FY 2019-20. The empaneled developers /installers have agreed for supply, erection, testing, commissioning including warrantee (AMC/CMC)for 5 years' operation, maintenance for grid connected solar rooftop power projects in the state within the Cost specified in **Table-4.4** above.Hence, there shall be no O&M expenses & maintenance of spares related costs during the first 5 years over 25 years' period in the Tariff determination process.

ii. MNRE Cost Benchmark for rooftop solar PV plant for FY 2019-20

The Ministry of New and Renewable Energy (MNRE) vide circular No. 318/38/2018-GCRT Date: 15 June 2018 specified the Benchmark costs for Off-grid Solar PV Systems and Grid Connected Rooftop Solar Power Plants for the Year 2019-20. The rates

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recommended by MNRE for grid connected rooftop solar plant are provided in table below:

Table4.6: MNRE Benchmark cost for Grid connected rooftop solar Power plant for FY 2019-20

Above 1kW to 10 kW	Above 10kW up to 100 kW	Above 100 kW up to 500 kW
Rs 60,000 /kWp	Rs 55,000 / kWp	Rs 53,000 /kWp

iii. Conclusion of the Analysis

The capital cost for rooftop solar power plant discovered in (i) Market approach (ii) Bidding /tender approach and (iii) MNRE benchmark capital cost for FY 2019-20 is presented in the following table:

Table4.7: Capital cost for rooftop solar power plant for FY 2019-20

Sl. No	Particulars	Rooftop solar plant Capacity		
		1-10 kW (Rs/kWp)	>10kW-100kW (Rs/kWp)	>100-500kW (Rs/kWp)
1	Market Approach (FY 2018-19)	63,265	59,600	55,300
2	MNRE bench mark (FY 2018-19)	60,000	55,000	53,000
3	MANIREDA EoI (FY 2018-19)	60,000	55,000	53,000

The above analysis shows that there is no substantial difference in the capital cost determined under market approach and MNRE benchmark cost specified for FY 2018-19. Moreover, the developer/installers have agreed to execute the solar rooftop projects as per the rates specified by MANIREDA /MNRE during phase III (FY 2018-19). At present MNRE benchmark cost for FY 2019-20 is not available. In view of this, the petitioner feels it appropriate to propose the benchmark cost for determination of tariff for roof top and small scale solar power plants for FY 2019-20 equal to the MNRE benchmark cost for FY 2018-19. The FY 2018-19 is about to end the capital cost and other parameters proposed by the petitioner may considered valid for FY 2019-20.

Table4.8: Capital cost for rooftop solar power plant proposed for FY 2019-20

Sl. No	Particulars	Rooftop solar plant Capacity		
		1kW-10 kW (Rs/kWp)	>10kW-100kW (Rs/kWp)	>100-500kW (Rs/kWp)
1	<i>Benchmark Cost (FY 2019-20)</i>	60,000	55,000	53,000

Commission’s Analysis

As against the Capital Cost for roof top and small solar plant as per market report, the MANIREDA has proposed capital cost for various capacities as in table 4.5 supra, after inviting expression of interest for empanelment of firms for implementation of grid connected roof top solar power plants in Manipur and fixed the rates for different capacities of roof top solar projects to be installed

Accordingly, the Commission has approved the bench mark cost for various capacities of roof top solar projects as projected by MANIREDA as detailed in the table below for FY 2019-20.

Table4.9: Bench mark cost approved by the Commission for FY 2019-20

Sl. No	Particulars	1kW- 10kW	10kW- 100kW	100kW-500kW
1	Bench mark cost	Rs. 60,000/kW	Rs. 55,000/kW	Rs. 53,000/kW

However, transparency bidding process be followed as per the guidelines OM No.03/88/2015-16/GCRT, Dt.8.09.2016 to undertake transparent bidding process for discovery of prices for installation of solar rooftop projects. Any violation of these guidelines would make them ineligible for availing CFA from MNRE. Further, the advance amount released shall have to be refunded back to the Ministry along with interest accrued there on.

Overall Capital Cost

Further the MANIREDA has considered the rates of various other components of the plant as approved by the Commission in its Order dated 02.11.2016. Detailed cost of various capacities of solar roof top projects are approved as detailed in the table below.

Table 4.10: Detailed capital cost approved by the Commission

Sl. No.	Particulars	1-10kW	Above 10-100kW	Above 100-500kW
1	Solar Modules	22800	21700	21500
2	Inverters	10000	8000	7000
3	Mounting Structures	6000	5000	4500
4	Balance of System	6000	6000	6000
5	Installation	5000	5000	5000

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Sl. No.	Particulars	1-10kW	Above 10-100kW	Above 100-500kW
6	Transportation at 15%	6700	6100	5800
7	Contingency at 3%	1300	1200	1200
8	Taxes at 5%	2200	2000	2000
9	Total Cost* (per kW)	60000	55000	53000

* After rounding to the nearest hundred.

Note: Transportation charges, Taxes and Contingency charges are worked out on items 1 to 4

The Commission, thus, approves the capital cost for rooftop solar PV Projects as below:

a)	From 1kW to upto 10 kW	Rs. 60000/kW
b)	Above 10 kW and upto 100 kW	Rs. 55000/kW
c)	Above 100 kW and upto 500 kW	Rs. 53000/kW

4.3 Capacity Utilisation Factor (CUF) Petitioner's Submission

Capacity Utilization factor (CUF) represents important parameter that influence the economics of the solar roof top projects. Most of the State Electricity Regulatory Commissions, as well as the CERC has adopted a normative capacity utilization factor of 19% for tariff determination purpose. The Hon'ble JERC in the previous tariff order dated 2.11.2016 has also considered the normative CUF of 19% for tariff determination purpose.

In this context, the petitioner would like to submit following facts for kind consideration of the Commission

- i. The Solar Irradiance and number of sunny days as well as sunshine hours in a year are low in North East states especially in Manipur compare to rest part of India.
- ii. Frequent fluctuation in grid voltage/ unscheduled cut in most of the part of the state result in frequent interruption in inverter operation affecting the injection of electricity from rooftop solar plant into the grid. The inverter cannot operate when grid voltage and frequency is not within its threshold design limit
- iii. The accumulation of dust on the solar panel shall also affect the generation.

To arrive at the reasonable normative CUF for tariff determination, the petitioner has therefore analyzed the actual generation data of the grid connected roof top projects operational in the state of Manipur from last two years. Following methodology is adopted by the petitioner for arriving at normative CUF for tariff determination purpose for FY 2019-20.

Table 4.11: Methodology for calculation of normative CUF for tariff determination purpose

1	Total number of rooftop solar plants operational in the state	106 Nos
2	Solar rooftop plants which have completed minimum 12 months of operation	42 Nos
3	Average CUF of the 42 numbers of operational solar rooftop plants	12.62%

Commission's Analysis

The MANIREDA has submitted that the solar irradiance and number of sunny days as well as sunshine hours in a year are low in North eastern states, especially in Manipur state when compared to rest of India for which the MANIREDA has collected data of generation and number of sunny days for 42 solar roof top plants which have completed one year of operation out of total 106 plants in the state. The average CUF of the 42 number of operational solar roof top plants worked out to 12.62% and requested the Commission to consider the CUF at 12.62%.

As verified from the data furnished by MANIREDA for 42 roof top solar plants in operation, the CUF varies from 8.65% to 15.35%.

Apart from number of sunny days the CUF depends on

- (i) Quality of panels
- (ii) Maintenance of panels i.e., regular cleaning of panels.
- (iii) Orientation of panels

So it is not correct to adopt the average CUF of 12.62% for the plants in operation. Moreover, the MANIREDA in their tariff workings have adopted the capacity reduction at 0.5% each year from fifth (5th) year onwards until the useful life period of 25 years gradually in doing so their CUF at the 25th year was adopted as 11.36% which would mean 2hrs 44 minutes only. This is having a very adverse impact on the Tariff and also affects the real idea of purchase of energy from solar, which shall not be allowed to happen.

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Earlier, the Commission approved CUF at 19% as per Regulation-58 of JERC for Manipur and Mizoram (Terms and Conditions for tariff determination from renewable sources) regulation, 2010. But the Commission had made the following analysis in the aspect of CUF duly considering the list of 42 observed generators data provided in the petition.

The list of observations and the range wise CUFs are as follows:

CUF Range (within)	No. of Observations	% in Total	Group-1	Group-2	Group-3
8%-<9%	2	4.76%			
9%-<10%	2	4.76%			
10%-<11%	5	11.90%	83.33%	61.90%	38.10%
11%-<12%	4	9.52%			
12%-<13%	10	23.81%			
13%-<14%	7	16.67%			
14%-<15%	9	21.43%			
15%-<16%	3	7.14%			
Total No.	42	100%			

As seen from the above table, 61.90% of the existing generators are falling within the CUF range of 12% to less than 15%. Among those, 38% are having the CUF between 13% and less than 15%. While, it is also important to take into account the number of sunny hours possible generally in a day of 24 hours for determination of the energy output. The consideration of CUF at 12.62% (as proposed by MANIREDA) would mean only mere sunny hours of 3hrs 2 minutes(3:02) only during each day, which appears to be inappropriate. The Commission deeply analyzed the no. of possible hours in a day vis-a-vis the CUF before making a conclusive decision on the CUF on considering the data tabulated below:

CUF	No. of Hours in a day
11.36%	2:44 Hrs
12.50%	3:00 Hrs
13%	3:07 Hrs
13.50%	3:14 Hrs
14%	3:22 Hrs
14.50%	3:29 Hrs
15%	3:36 Hrs

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15.50%	3:43 Hrs
16%	3:50 Hrs
16.67%	4:00 Hrs
19%	4:34 Hrs

As seen from the table, it can be noted that 14.50%, 15% & 16% CUF works out to be close to **3 hrs 22 minutes** for 14.5% CUF, **3hrs 36 minutes** for 15% CUF and it is **3hrs 50 minutes for 16% CUF**. The increase in number of minutes is only 14 minutes more than **3.50 hrs** for the CUF from 15% to 16% CUF. The Manipur is an area with more of flat in surface and the sunray availability is predominantly more from morning 6.30AM to 2.00PM without any hindrance from hillocks or any other obstruction to sun rays. It looks more justifying to expect a good sunny exposure of 4 hours a day and it is more conservative also and anything lesser than this level would be more unjustifiable from the Commission point of view and Distribution Company (the buyer) would be subjected to undesirable injustice and more burdening to comply with RPO obligation. So considering 16% CUF (i.e., 3 hrs 50 minutes) as against the already MANIREDA proposed 3hrs 2 minutes would not really be a burden to the generator but ignoring this fact would certainly affect the prospective buyer adversely. Besides, if the generators adopt more diligent in timely & promptly cleansing and properly positioning of SPV panels would help them to achieve a CUF higher than 16%.

In order to make a balancing conclusion for both the parties, the Commission carefully prefers to adopt the CUF at 16% instead of 12.62% as proposed in the petition by MANIREDA and their adoption of gradually reduction (i.e., 0.5% CUF in each year from 5th year) in CUF so as to bring down to 11.36% over the project life of 25 years.

Accordingly, the Commission strongly prefers to consider the CUF at 16% (sixteen percent) for the tariff determination purpose. In addition, no reduction in plant capacity is allowed throughout the project life though MANIREDA has adopted 0.5% reduction in the CUF from 5th year onwards till the end of useful project life.

4.4 Life of plant and machinery:

As specified under clause 2 of JERC (terms and conditions for determination RE tariff) first amendment, Regulations 2014, the petitioner has considered 25

(twenty-five) years as the useful life of the plant and machinery. The Commission too prefers to adopt the same.

4.5 Debt: Equity Ratio

- i. **Debt: Equity ratio:** As specified in JERC (terms and conditions for determination RE tariff) Regulations 2010, the petitioner has considered Debt: Equity ratio as 70:30.
- ii. **Loan Tenure:** The loan repayment period of 12 years is considered in line with the JERC (terms and conditions for determination RE tariff) first amendment, Regulations 2014.
- iii. **Interest on Debt:** As specified in JERC (terms and conditions for determination RE tariff) first amendment, Regulations 2014, the petitioner has considered interest on debt as 300 basis points above the average SBI base rate prevalent during first six months of the previous year. Therefore, the SBI base rates considered are:

Effective date	Interest Rate
01.04.2018	8.70%
01.07.2018	8.95%

Commission's decision

In terms of JERC for Manipur and Mizoram (Terms and Conditions for determination of RE Tariff) Regulation 2010 read together with 1st amendment Regulations 2014, the Commission approves Debt: Equity ratio of 70:30 for solar roof top plants and loan repayment period be 12 years and rate of interest on debt at 11.83% as projected by MANIREDA.

The Commission approves loan repayment period of 12 years and rate of interest on debt at 11.83% for FY 2019-20 as projected by MANIREDA.

4.6 Depreciation Petitioner's Submission

In line with JERC (terms and conditions for determination RE tariff) first amendment, Regulations 2014 the depreciation is computed at the rate of 5.83% per annum for

the first 12 years of Tariff period and the remaining depreciation amount is spread over the remaining useful life of the project.

Commission's Analysis

The Commission considers 5.83% for first 12 years to provide adequate depreciation to meet the loans repayment and annual depreciation of 1.54% for the balance period over 12 years.

The Commission to allow depreciation at 5.83% for the first 12 years and at 1.54% for the balance 13 years on the capital cost of the project.

4.7 Operation and Maintenance Expenses

Petitioner's Submission

The clause-11 of JERC (terms and conditions for determination RE tariff) first amendment, Regulations 2014 allows to escalate the O&M expenses of base year @ 5.72% per year. Accordingly, the petitioner has escalated the O&M cost approved by the Commission in previous tariff order dated 2.11.2017 by 5.72% and thus consider Rs.1537/kW as O&M expense for determination of tariff during FY 2019-20. The MANIREDA in their tariff petition has preferred not to claim O&M expenses during the first five (5) years. This is a welcome inclusion in the tariff calculations made by them in their tariff petition. **The Commission had also agreed to adopt the same in the tariff determination.**

Commission's Analysis

Accordingly, the Commission has considered O & M expenses at Rs.1537/kW for FY 2019-20 as projected by MANIREDA.

4.8 Interest on Working Capital

Petitioner's Submission

The petitioner has computed the working capital in accordance with the JERC (terms and conditions for determination RE tariff) Regulations 2010 comprising of:

- (a) Operation and maintenance cost for one month,
- (b) Receivables equivalent to two (2) months of net energy charges for the sale of electricity calculated on the normative CUF and
- (c) Maintenance spares @15% of O&M expenses.

The JERC first amendment, Regulations 2014 allows interest on working capital as average SBI base rate prevalent during first six months plus 350 basic points. Accordingly, the petitioner has considered interest on working capital as 12.33 % per annum based on average base rate prevailing during first six months during FY 2018-19 as derived above.

Commission's Analysis

The Commission has considered rate of Interest on working capital at 12.33% for FY 2019-20.

Since, the O&M expenses are not being claimed during the first five (5) years by the MANIREDA in their tariff calculations, the same analogy shall also be adopted for the maintenance of spares during the same first five years of project period. Therefore, the component of Maintenance of Spares would not be taken into consideration in the tariff calculations in arriving at the tariffs during the first five years of the tariff period by the Commission.

4.9 Return on Equity

Petitioner's Submission

JERC (terms and conditions for determination RE tariff) first amendment, Regulations 2014 allows 20% RoE for the first 10 years and 24% RoE from 11th year onwards. The petitioner too has considered the same.

Commission's Analysis

Based on the decisions of CERC and other SERCs and by the Commission in its Tariff Order of January, 2015, the Commission considers the RoE as follows:

- (i) **20% for the first 10 years**
- (ii) **24% from the 11th year onwards**

Thus, the Commission has approved ROE at 20% for first 10 years and 24% from 11th year onwards as was projected by MANIREDA.

4.10 Discounting Factor

Petitioner's Submission

CERC (terms and conditions for Tariff determination from Renewable Energy Sources) Regulations, 2012 has recommended post tax weighted average cost of

capital (WACC) as discount rate for determination of Levelised tariff. JERC in previous tariff order 02.11.2016 has considered WACC as the addition of cost of debt and cost of equity. The cost of debt is calculated based on normative interest rate, while the cost of the equity is calculated based on the return on equity. Accordingly, the petitioner has considered the discount factor (DF) 12.50% to calculate the Levelised tariff.

Commission's Analysis

The Commission notes that the financing of capital cost is in the debt equity ratio of 70:30 respectively. Considering cost of debt and cost of equity, it is considered that the weighted average cost of capital employed is appropriate for determining the discount factor.

Since, the Commission has allowed the actual tax paid by the Generator as a pass through annually limited to the amount of equity considered in this Order, the computation of discount factor does not include the tax component.

Hence, considering 70% of the capital cost at 11.83% interest rate and 30% of equity at the rate 16% for RoE, the Commission decides to allow discount factor of 13.08% -- $[(11.83\% \times 0.7) + (16\% \times 0.3)]$ as projected by MANIREDA.

4.11 Other Issues

4.11.1. Metering

As per clause 5.1 of JERC for M&M (Metering for grid connected renewable energy) Regulations 2016, the distribution licensee shall provide net or gross metering arrangement to any eligible consumer or third party owner as long as the total capacity (in MW) does not exceed the target capacity for the annual renewable purchase obligation (RPO) requirement determined by the Commission from time to time.

Provided that initially a total maximum cumulative capacity of 10 MW in respect of grid connected solar energy system shall be allowed under net and gross metering,

on yearly basis until reviewed by the Commission, in the area of supply of the distribution licensee.

Individual households, industries, offices, commercial establishments, institutions, residential complexes etc. will be eligible for project capacity of minimum 1 kW up to maximum of 500 kW with/without battery backup support under net metering system. Consumers will generate solar power for self-consumption and can feed excess power into the grid through a bi-directional export and import meter of power separately.

As per proviso of clause 3.6 of JERC for M&M (Metering for grid connected Renewable Energy) Regulations, 2016, Gross metering arrangement shall be installed only after power purchase agreement is executed between the developer or eligible consumer and the distribution licensee or open access consumer as the case may be.

As per proviso of clause-11.3 of JERC for M&M (Metering for grid connected Renewable Energy) Regulations, 2016 the cost of meter shall be borne by the renewable energy generator. If consumer provides meter no need to pay cost of meter to distribution licensee.

4.11.2 Procedure for billing and energy accounting in respect of net metering roof top solar power plant

As stipulated in clause-12.2 of JERC for M&M Metering for grid connected renewable energy of Regulations, 2016, the gross metering procedures are detailed below:

- (1) For each billing cycle the consumer shall receive an energy account statement showing quantum of electricity injected by the eligible consumer in the billing period, electricity supplied by the distribution licensee in the billing period, net billed electricity for payment by the consumer for that billing cycle and net carried over electricity to then next billing period separately.
- (2) In case the electricity injected exceeds the electricity consumed from licensee's supply system during the billing cycle such excess injected electricity shall be

carried forward to the next billing cycle as electricity credit and shown as electricity exported by the consumer for adjustment against the electricity consumed in subsequent billing periods within the settlement period. In such a case, the distribution licensee shall issue an invoice containing all these details.

- (3) In case the electricity supplied by the distribution licensee during any billing period exceeds the electricity injected by the eligible consumer, the distribution licensee shall raise a bill for net electricity consumption as per applicable tariff of that category after taking into account any electricity credit balance from previous billing period.
- (4) In case the eligible consumer is under the ambit of TOD tariff, the electricity consumption in anytime block i.e. peak hours, off peak hours etc. shall be first compensated with the electricity injected in the same time block. Any excess injection over and above the consumption in any other time block in a billing cycle shall be accounted as if the excess injection occurred during non-peak hours.
- (5) The surplus energy measured in kWh/kVAh shall be utilized to offset the consumption measured in kWh/kVAh and may not be utilized to compensate any other fee and charges imposed by the licensee as per the orders of the Commission. A normative power factor of 0.9 shall be considered for conversion of kWh to kVAh, wherever applicable.
- (6) The monthly fixed charge and other fees and charges as per applicable Tariff Order of the Commission shall be leviable on contract demand or contracted load of the consumer for each billing cycle. The monthly fixed charge shall not be leviable on the capacity of grid connected renewable energy system of the eligible consumer.**
- (7) The distribution licensee shall also take the reading of solar meter for recording total solar power generated by solar energy system of eligible consumer.
- (8) The distribution licensee in addition to consumer tariff shall be eligible to raise invoice/bills for any other charges as allowed by the Commission.
- (9) In case of any dispute in billing, the consumer can approach the licensee, who will deal the complaint under provisions of Regulations 6.24 to 6.27 of the JERC for Manipur and Mizoram (Electricity Supply Code) Regulations, 2013 with

subsequent amendments thereof. In case the consumer feels aggrieved by the licensee's disposal of the complaint, the consumer can approach Consumer Grievances Redressal Forum and Electricity Ombudsman in accordance with JERC for Manipur and Mizoram (Consumer Grievance Redressal) Regulations, 2010, as amended from time to time.

- (10) The consumer shall be paid for net energy credits which remains unadjusted at the end of the settlement period at the levelised tariff (**feed-in-tariff**) determined and fixed by the Commission from time to time depending on prevailing circumstances.

Provided also that at the beginning of each settlement period, cumulative carried over solar electricity injected shall be reset to zero.

4.11.3 Procedure for billing and energy accounting in respect of gross metering roof top solar energy system

As stipulated in clause 12.3 of JERC for M&M Metering for grid connected renewable energy) Regulations, 2016, the gross metering procedures are detailed below:

- (1) The distribution licensee shall bill to the eligible consumer in whose premises grid connected rooftop solar energy system is installed, for electricity supplied by it, in accordance with tariff applicable to the consumer category and the applicable Electricity Supply Code.
- (2) For electricity injected to the licensee's grid from solar energy system, joint monthly reading or any other mechanism approved by the Commission in respect of power exported to licensee shall be taken by the authorized representative of the seller (i.e. developer of the solar power plant) and the licensee. The seller shall submit monthly invoice for energy sold to licensee after each meter reading duly supported by the joint meter reading document and photograph of the energy meter showing reading.
- (3) The applicable tariff for the rooftop solar energy shall be the levelised tariff determined and fixed by the Commission from time to time. Terms and conditions of payment of the cost of power purchased by the licensee from the

seller shall be as per mutually agreed and duly incorporated in the power purchase agreement executed between the eligible consumer or third party owner of the solar energy system and the licensee as the case may be.

4.11.4 Penalty and Compensation

In case of failure of net metering system, the provisions of penalty or compensation shall be as per the provisions of the Standards of Performance Regulations for Distribution Licensee.

4.11.5 Need to purchase the energy quantum to comply with RPO obligation

The Distribution licensee shall purchase the energy quantum from the Rooftop SPV generators at the rates specified in this order to the extent of the quantity they needed to comply with the Renewable Purchase Obligations percentage already notified by the Commission in this regard from the local generators only.

4.12 MNRE Subsidy

MNRE in its notification dated 4th March 2016, has notified subsidy benefit to an extent of **70% of benchmark capital cost for grid connected solar rooftop projects installed in the Northeast. The subsidy benefit is only limited to residential, health /educational institutions and other social sector such as welfare houses, NGOs, training institutions, Orphanages, etc.** and no subsidy is provided to Govt./PSU buildings / institutions, commercial and industrial buildings. However, Government buildings/ institutions, Public sector under takings, all buildings owned by Government directly or by any Government owned societies, companies, corporations, institutions or organisations, Government educational/health institutions are eligible **for achievement linked incentives.**

MNRE in its letter No. 03/88/2015-16/GCRT dated 30.03.2017 has issued detailed instructions on achievement linked incentives as detailed below.

Therefore, separate tariffs are approved for entities availing subsidy and not availing subsidy.

The achievement linked incentives vis-a-vis **sanctioned/approved capacity/ allocated** targets will be applicable to all Government Institutions including

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Ministries/ Departments/ Organisations of both Central and State Governments and PSUs. The provisions for achievement-linked incentives will be as follows:

Sl. No	Achievement vis-a-vis Target Allocation	**Incentives for General Category States/UTs	**Incentives for Special Category States/UTs/ Islands*
1	80% and above within the sanctioned period	Rs. 16,250/- per KW	Rs. 39,000/- per KW
2	Below 80% and above 50% (including 50%) within the sanctioned period	Rs. 9,750/- per KW	Rs. 23,400/- per KW
3	Below 50% and above 40% (including 40%) within the sanctioned period	Rs. 6,500/- per KW	Rs. 15,600/- per KW
4	Below 40% within the sanctioned period	Nil	Nil

*Special Category States / UTs/ Islands include- **North-eastern States including Sikkim, Uttarakhand, Himachal Pradesh, Jammu & Kashmir, Andaman & Nicobar Islands and Lakshadweep Islands.**

** The incentives indicated above are subject to revision on annual basis.

In case of CAPEX mode:

The cost/tariff of the project should be firmed up through a transparent bidding process.

The maximum incentive, for Sl. No. 1 in the above table, will be limited to 25% of the benchmark cost **or** the cost arrived through competitive bidding process, whichever is lower for general category States /UTs. In case of **Special Category States/UTs/ Islands, 60% of the benchmark cost** or the cost arrived through competitive bidding process, whichever is lower.

Similarly, for Sl. No. 2 above, Incentive will be limited to 15% for general category States/UTs. For **special category States/UTs/ Islands the incentive is at 36%.**

For Sl. No. 3 above, Incentive will be limited to 10% for general category States/UTs and **24% for special category States/UTs/ Islands.**

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In case of RESCO mode:

In this case, the developers are selected through a tariff-based reverse bidding. The incentive amount will be up to 25% of the bench mark cost as mentioned in the table above for general category States/UTs. The benefit of the incentives should be passed on to the customer in the form of reduced tariff by factoring incentive. **In case of special category States/UTs/Islands the applicable incentives will be up to 60% of the bench mark cost.**

4.13 Abstract of Technical and Financial parameters adopted in this Order are indicated below.

Sl. No	Technical & Financial items	Parameters adopted		
		1kW-10KW	>10kW-100KW	>100kW-500KW
1	Capital Cost of Power Project (Rs.)	60,000	55,000	53,000
2	Capacity Utilization factor	15%	15%	15%
3	Annual Gross Generation (kWh)	1314	1314	1314
4	Auxiliary Consumption (%)	0	0	0
5	Non - Depreciable Amount / Salvage value (Rs.)	6,000	5,500	5,300
6	Depreciable Amount (after salvage value) (Rs.)	54000	49500	47700
7	Debt Fraction	70%	70%	70%
8	Loan/Debt (Rs.)	42000	38500	37100
9	Equity (Rs.)	18000	16500	15900
10	TOTAL (Debt + Equity) (Rs.)	60000	55000	53000
11	Interest Rate on Term Loan	11.83%	11.83%	11.83%
12	Repayment Period (Yrs)	12	12	12
13	Moratorium Period (Yrs)	0	0	0
14	Term loan period for principal payment (Yrs)	12	12	12
15	Depreciation for First 12 years (Straight Line)	5.83%	5.83%	5.83%
16	Depreciation for Next 13 years (Straight Line)	1.54%	1.54%	1.54%
17	Discounting Rate	13.08%	13.08%	13.08%
18	O&M cost (Rs.)	1537	1537	1537
19	O&M Cost annual escalation	5.72%	5.72%	5.72%
20	Insurance Cost	0%	0%	0%
21	Return on Equity (first 10 years)	20%	20%	20%

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Sl. No	Technical & Financial items	Parameters adopted		
		1kW-10KW	>10kW-100KW	>100kW-500KW
22	Return on Equity (11 th year onwards)	24%	24%	24%
23	Interest on working capital rate	12.33%	12.33%	12.33%
24	Minimum Alternative Tax (First 10 years)	21.34%	21.34%	21.34%
25	Corporate Tax (Last 10 years)	34.61%	34.61%	34.61%
26	MNRE Subsidy / CFA (% of Capital Cost)	70%	70%	70%

4.14 Tariff

Based on the above assumptions, the levelised tariff (**feed-in-tariff**) for solar rooftop projects with and without subsidy for Residential buildings, Institutions and Social Sector under takings are approved by the Commission as indicated in the table below:

Sl. No	Category	Unit	1kW upto 10 kW	> 10kW upto 100 kW	> 100 kW upto 500kW
1	Without Subsidy	Rs./kWh	7.89	7.33	7.10
Levelised Tariff for Residential, Institutional and Social sector (Rs./kWh)					
2	With 70% Subsidy	Rs./kWh	3.16	2.99	2.92
Levelised Tariff for Governmental Institutions (Rs./kWh) based on achievement					
3	With 60% incentive	Rs./kWh	3.84	3.61	3.52
4	With 36% incentive	Rs./kWh	5.46	5.10	4.95
5	With 24% incentive	Rs./kWh	6.27	5.84	5.67

The above tariffs are applicable to all those projects which are being set up/commenced during the FY 2019-20 and these rates are to be adopted for the entire project life as per their applicability. The detailed tariff calculations sheets for each tariff indicated are appended to this order as Annexures at the end.

- a) Under the 70% subsidy, **the Institutions** include the Schools, health institutions such as medical colleges & hospitals, universities and Educational Institutions etc which were registered under Not-For-Profit motive.
- b) Under the 70% subsidy, the **Social Sector** shall include Community centres, welfare homes, old age homes, orphanages, Common service centres and

Common workshops for artisans or craftsman facilities for use of community, Trusts/NGOs/Voluntary organisations/Training Institutions, any other establishments for common public use etc. All the above social sectors shall have to be registered under the Not-For-Profit Organisations only.

- c) All residential/institutional/social sectors shall be deemed to availed 70% subsidy. All residential/institutional/social sectors who claim subsidy less than 70% or no subsidy shall have to produce a documentary proof issued by the MNRE and MANIREDA to DISCOM/licensee. The DISCOM/Licensee (who is procuring such power) shall have to be satisfied with such documentary proof before allowing for applicable higher Feed In Tariff (FIT).
- d) In case of Governmental Institutions, the bench mark costs shall have to be determined based on achievement linked incentives percentages as specified in this regard. Basically, all the Governmental Institutions shall be deemed to have received 60% incentive for the purpose of applicability of tariff indicated in this order. However, the governmental institutions those have actually received lesser incentives than 60% and thereby prefers to claim for corresponding feed-in-Tariff (FIT) shall have to submit the documentary evidence issued by the MNRE (Ministry of New and Renewable Energy) and MANIREDA to the distribution company (DISCOM) or licensee in proof of the actual incentive so received. Upon such submission the Distribution Company/Licensee, the buyer of such power, may permit for higher Feed In Tariff (FIT) corresponding to the relevant incentives actually eligible after due verification of the factual and on being satisfied only.

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ANNEXURES

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ATTENDANCE LIST ON PUBLIC HEARING
FOR DETERMINATION OF TARIFF FOR SOLAR ROOFTOP PROJECTS

Date & Time : 6th March, 2019 (Wednesday) from 11:00 a.m.

Venue : Hotel Classic, Regency Hall, imphal.

Sl. No.	Name of the Participant	Designation/ Organisation
1.	Er.Lalchharliana Pachuau	Chairperson, JERC (M&M)
2.	Er.Ng. Sarat Singh	Member, JERC (M&M)
3.	Mr.L. Manglem Singh	Director, MANIREDA
4.	Mr.H. Thanthianga	Asst. Chief (Engg.), JERC (M&M)
5.	Mr.Richard Zothankima	Asst. Secy., JERC (M&M)
6.	Mr.Babita Thangjam	Scientific Officer, MANIREDA
7.	Mr.Md. Agha Khan	Project Officer, MANIREDA
8.	Mr.Satadru Chakraborty, WISE, Pune, Consultant, MANIREDA	Associate Fellow, World Institute of Sustainable Energy
9.	Mr.Y. Hemanta Singh	DEO, Rooftop Solar, MANIREDA
10.	Mr.Sandeep Guha Niyogi, WISE, Pune, Consultant, MANIREDA	Sr. Research Associate, CPP, WISE, Pune
11.	Mr.K. Hari Prasad	Consultant, ASCI, Hyderabad
12.	Mrs.N. Purnima	Dy. Manager, MSPDCL
13.	Mrs.Usham Rocky Singh	Manager, MSPDCL
14.	Mr.Tesah Janggougin Khongthang	Manager, MSPDCL
15.	Mr.L. Albert Singh	Manager, Triveni Solar
16.	Mrs.L. Dinita Devi	Office Assistant, M/s Achoubi Enterprises
17.	Mr.Mithun John Vaghre	Consultant, United Nations Development Programme
18.	Mr.Jodhachandra Lourambam	Deputy Manager, MSPDCL / Deputation to MANIREDA
19.	Mr.K. Jila Singh	G.M. (Comml), MSPDCL
20.	Mr.Th. Aton Singh	E.D. (Comml), MSPDCL
21.	Mr.S. Ramananda Singh	Promoter Solar
22.	Mr.Daniel Konjeagbam	Principal/Administrator, Bethel School, Nambol
23.	Mr.S. Kumadchandra Singh	Tin Tin Power Up
24.	Mr.I. Mocha Meitei	Impact TV
25.	Mr.R.C. Neangangcha	Impact TV

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Annexure-II

Range: 1kW-10 kW

Capacity: 1kW

S.No.	Particulars	Units	Rs./000s
1	Capital Cost	(000s)	60.00
2	Equity @ 30% of CC	(000s)	18.00
3	Debt @ 70% of CC	(000s)	42.00

CUF Opt	0
CUF Reduction	0.00% 5th year Onwards

Capital Subsidy	0%
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S.No.	Particulars	Units	Yrs -->	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
1	Installed Capacity	kW		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Cap. Utilsn. Factor	%		16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
3	Gross Energy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402
4	Net Enrgy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402

Interest on Working Capital workings (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn - 1 mth	(000s)		-	-	-	-	-	0.17	0.18	0.19	0.20	0.21	0.22	0.24	0.25	0.26	0.28	0.30	0.31	0.33	0.35	0.37	0.39	0.41	0.44	0.46	0.49
2	Maint. Spares as (% of O&M expn	(000s)	15%	-	-	-	-	-	0.30	0.32	0.34	0.36	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.56	0.59	0.63	0.66	0.70	0.74	0.78	0.83	0.88
3	Receivables - 2mths	(000s)		2.02	1.95	1.88	1.81	1.74	2.02	1.97	1.92	1.87	1.83	1.91	1.86	1.42	1.45	1.48	1.51	1.55	1.59	1.62	1.67	1.71	1.76	1.81	1.86	1.91
4	Total W/Cap required	(000s)		2.02	1.95	1.88	1.81	1.74	2.49	2.47	2.45	2.43	2.42	2.53	2.52	2.12	2.19	2.26	2.34	2.42	2.51	2.60	2.70	2.80	2.91	3.03	3.15	3.28
6	Interest on W/Cap	(000s)	12.33%	0.25	0.24	0.23	0.22	0.21	0.31	0.30	0.30	0.30	0.30	0.31	0.31	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.35	0.36	0.37	0.39	0.40

Tariff for Solar PV calculation (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn with Escl.	(000s)	5.72%	-	-	-	-	-	2.03	2.15	2.27	2.40	2.54	2.68	2.83	3.00	3.17	3.35	3.54	3.74	3.96	4.18	4.42	4.68	4.94	5.23	5.52	5.84
2	Depreciation	(000s)	5.83%	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
3	Int. on Debt	(000s)		4.76	4.35	3.93	3.52	3.11	2.69	2.28	1.86	1.45	1.04	0.62	0.21	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Return on Equity	(000s)		3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32	4.32
5	Int. on W/Capital	(000s)		0.25	0.24	0.23	0.22	0.21	0.31	0.30	0.30	0.30	0.30	0.31	0.31	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.33	0.35	0.36	0.37	0.39	0.40
6	Gross Total of Tariff	(000s)		12.11	11.69	11.26	10.84	10.42	12.13	11.83	11.53	11.25	10.97	11.43	11.17	8.50	8.68	8.87	9.07	9.29	9.51	9.75	10.00	10.26	10.55	10.84	11.16	11.49

Levelled Tariff for the period (Per unit cost)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn Cost	Rs./kWh		-	-	-	-	-	1.45	1.53	1.62	1.71	1.81	1.91	2.02	2.14	2.26	2.39	2.53	2.67	2.82	2.98	3.16	3.34	3.53	3.73	3.94	4.17
2	Depreciation	Rs./kWh		2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
3	Int. on Debt	Rs./kWh		3.40	3.10	2.81	2.51	2.22	1.92	1.62	1.33	1.03	0.74	0.44	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Return on Equity	Rs./kWh		2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	2.57	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08	3.08
5	Int. on W/Capital	Rs./kWh		0.18	0.17	0.17	0.16	0.15	0.22	0.22	0.22	0.21	0.21	0.22	0.22	0.19	0.19	0.20	0.21	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29
6	Gross Total of Tariff	Rs./kWh		8.64	8.34	8.04	7.73	7.43	8.65	8.44	8.23	8.02	7.82	8.16	7.97	6.07	6.19	6.33	6.47	6.62	6.79	6.95	7.13	7.32	7.52	7.74	7.96	8.20
7	Disc. Factor		13.08%	1.00	0.88	0.78	0.69	0.61	0.54	0.48	0.42	0.37	0.33	0.29	0.26	0.23	0.20	0.18	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05
8	Tariff Product			8.64	7.37	6.28	5.35	4.55	4.68	4.04	3.48	3.00	2.59	2.39	2.06	1.39	1.25	1.13	1.02	0.93	0.84	0.76	0.69	0.63	0.57	0.52	0.47	0.43
9	Levelled Tariff			7.89																								

Int. on Debt Calculation

(Amount in Thousands)

(Amount in Thousands)

S.No.	Particulars	Yrs -->	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Opng. Balnc		42.00	38.50	35.00	31.50	28.00	24.50	21.00	17.50	14.00	10.50	7.00	3.50	0
2	Repayment		11.83%	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	0
3	Cls. Balnc		38.50	35.00	31.50	28.00	24.50	21.00	17.50	14.00	10.50	7.00	3.50	0.00	0
4	Avg. Loan		40.25	36.75	33.25	29.75	26.25	22.75	19.25	15.75	12.25	8.75	5.25	1.75	0
5	Int. on Loan/Debt		4.762	4.348	3.933	3.519	3.105	2.691	2.277	1.863	1.449	1.035	0.621	0.207	0

Tariff Order for Roof Top Solar Plants in Manipur

ANNEXURE-III

Range: 10kW-100 kW

Capacity: 1kW

S.No.	Particulars	Units	Rs.in 000s
1	Capital Cost	(000s)	55.00
2	Equity @ 30% of CC	(000s)	16.50
3	Debt @ 70% of CC	(000s)	38.50

CUF Of 0
CUF Reduction 0.00% 5th year Onwards

Capital Subsidy 0%

S.No.	Particulars	Units	Yrs -->	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
1	Installed Capacity	kW		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Cap. Utilsn. Factor	%		16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
3	Gross Energy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402
4	Net Enregy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402

Interest on Working Capital workings (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn - 1 mth	(000s)		-	-	-	-	-	0.169	0.179	0.189	0.200	0.211	0.223	0.236	0.250	0.264	0.279	0.295	0.312	0.330	0.349	0.369	0.390	0.412	0.435	0.460	0.487
2	Maint. Spares as (%) of O&M expn	(000s)	15%	-	-	-	-	-	0.304	0.322	0.340	0.360	0.380	0.402	0.425	0.449	0.475	0.502	0.531	0.561	0.594	0.627	0.663	0.701	0.741	0.784	0.829	0.876
3	Receivables - 2mths	(000s)		1.850	1.785	1.721	1.656	1.592	1.882	1.838	1.795	1.753	1.713	1.786	1.748	1.342	1.372	1.404	1.438	1.473	1.511	1.550	1.592	1.636	1.683	1.733	1.785	1.840
4	Total W/Cap required	(000s)		1.850	1.785	1.721	1.656	1.592	2.356	2.339	2.324	2.313	2.304	2.411	2.409	2.042	2.112	2.186	2.264	2.346	2.434	2.526	2.624	2.727	2.837	2.952	3.074	3.203
6	Interest on W/Cap	(000s)	12.33%	0.228	0.220	0.212	0.204	0.196	0.290	0.288	0.287	0.285	0.284	0.297	0.297	0.252	0.260	0.269	0.279	0.289	0.300	0.311	0.324	0.336	0.350	0.364	0.379	0.395

Tariff for Solar PV calculation (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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	
1	O&M Expn with Escl.	(000s)	5.72%	-	-	-	-	-	2.03	2.15	2.27	2.40	2.54	2.68	2.83	3.00	3.17	3.35	3.54	3.74	3.96	4.18	4.42	4.68	4.94	5.23	5.52	5.84	
2	Depreciation	(000s)	5.83%	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
3	Int. on Debt	(000s)		4.36	3.99	3.61	3.23	2.85	2.47	2.09	1.71	1.33	0.95	0.57	0.19	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	Return on Equity	(000s)		3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	3.96	
5	Int. on W/Capital	(000s)		0.23	0.22	0.21	0.20	0.20	0.29	0.29	0.29	0.29	0.28	0.30	0.30	0.25	0.26	0.27	0.28	0.29	0.30	0.31	0.32	0.34	0.35	0.36	0.38	0.39	
6	Gross Total Tariff	(000s)		11.10	10.71	10.32	9.94	9.55	11.29	11.03	10.77	10.52	10.28	10.71	10.49	8.05	8.23	8.43	8.63	8.84	9.06	9.30	9.55	9.82	10.10	10.40	10.71	11.04	

Levelised Tariff for the period (Per unit cost)

S.No.	Particulars	Units	Yrs -->	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	
1	O&M Expn Cost	Rs./kWh		-	-	-	-	-	1.45	1.53	1.62	1.71	1.81	1.91	2.02	2.14	2.26	2.39	2.53	2.67	2.82	2.98	3.16	3.34	3.53	3.73	3.94	4.17	
2	Depreciation	Rs./kWh		2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	
3	Int. on Debt	Rs./kWh		3.11	2.84	2.57	2.30	2.03	1.76	1.49	1.22	0.95	0.68	0.41	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	Return on Equity	Rs./kWh		2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	
5	Int. on W/Capital	Rs./kWh		0.16	0.16	0.15	0.15	0.14	0.21	0.21	0.20	0.20	0.20	0.21	0.21	0.18	0.19	0.19	0.20	0.21	0.21	0.22	0.23	0.24	0.25	0.26	0.27	0.28	
6	Gross Total of Tariff	Rs./kWh		7.92	7.64	7.37	7.09	6.81	8.06	7.87	7.68	7.50	7.33	7.64	7.48	5.75	5.88	6.01	6.15	6.31	6.47	6.64	6.82	7.01	7.21	7.42	7.64	7.88	
7	Disc. Factor		13.08%	8.25	1.00	0.88	0.78	0.69	0.61	0.54	0.48	0.42	0.37	0.33	0.29	0.26	0.23	0.20	0.18	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05
8	Tariff Product			60.41	7.92	6.76	5.76	4.90	4.17	4.36	3.76	3.25	2.81	2.42	2.24	1.94	1.31	1.19	1.08	0.97	0.88	0.80	0.73	0.66	0.60	0.55	0.50	0.45	0.41
9	Levelised Tariff			7.33																									

Int. on Debt Calculation

S.No.	Particulars	(Amount in Thousands)												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Opng. Balnc	38.50	35.29	32.08	28.88	25.67	22.46	19.25	16.04	12.83	9.63	6.42	3.21	0
2	Repayment	11.83%	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	0
3	Cls. Balnc	35.29	32.08	28.88	25.67	22.46	19.25	16.04	12.83	9.63	6.42	3.21	0.00	0
4	Avg. Loan	36.90	33.69	30.48	27.27	24.06	20.85	17.65	14.44	11.23	8.02	4.81	1.60	0
5	Int. on Loan/Debt	4.365	3.985	3.606	3.226	2.847	2.467	2.088	1.708	1.328	0.949	0.569	0.190	0

Tariff Order for Roof Top Solar Plants in Manipur

Annexure-IV

Range: 100kW-500 kW

Capacity: 1kW

S.No.	Particulars	Units	Rs.in 000s
1	Capital Cost	(000s)	53.00
2	Equity @ 30% of CC	(000s)	15.90
3	Debt @ 70% of CC	(000s)	37.10

CUF O	0
CUF Reductor	0.00% 5th year Onwards

Capital Subsid	0%
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S.No.	Particulars	Units	Yrs -->	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
1	Installed Capacity	kW		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Cap. Utilsn. Factor	%		16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
3	Gross Energy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402
4	Net Enrgy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402

Interest on Working Capital workings (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn - 1 mth	(000s)		-	-	-	-	-	0.169	0.179	0.189	0.200	0.211	0.223	0.236	0.250	0.264	0.279	0.295	0.312	0.330	0.349	0.369	0.390	0.412	0.435	0.460	0.487
2	Maint. Spares as (%) of O&M expn	(000s)	15%	-	-	-	-	-	0.304	0.322	0.340	0.360	0.380	0.402	0.425	0.449	0.475	0.502	0.531	0.561	0.594	0.627	0.663	0.701	0.741	0.784	0.829	0.876
3	Receivables - 2mths	(000s)		1.783	1.720	1.658	1.596	1.534	1.827	1.785	1.744	1.705	1.666	1.738	1.702	1.313	1.343	1.374	1.408	1.443	1.481	1.521	1.562	1.607	1.654	1.703	1.755	1.811
4	Total W/Cap required	(000s)		1.783	1.720	1.658	1.596	1.534	2.300	2.286	2.273	2.264	2.258	2.363	2.364	2.012	2.082	2.156	2.234	2.317	2.404	2.497	2.594	2.698	2.807	2.922	3.044	3.173
6	Interest on W/Cap	(000s)	12.33%	0.220	0.212	0.204	0.197	0.189	0.284	0.282	0.280	0.279	0.278	0.291	0.291	0.248	0.257	0.266	0.275	0.286	0.296	0.308	0.320	0.333	0.346	0.360	0.375	0.391

Tariff for Solar PV calculation (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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	
1	O&M Expn with Escl.	(000s)		-	-	-	-	-	2.030	2.146	2.269	2.398	2.536	2.681	2.834	2.996	3.168	3.349	3.540	3.743	3.957	4.183	4.422	4.675	4.943	5.226	5.524	5.840	
2	Depreciation	(000s)	5.83%	3.090	3.090	3.090	3.090	3.090	3.090	3.090	3.090	3.090	3.090	3.090	3.090	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816
3	Int. on Debt	(000s)		4.206	3.840	3.475	3.109	2.743	2.377	2.012	1.646	1.280	0.914	0.549	0.183	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	Return on Equity	(000s)		3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82	3.82
5	Int. on W/Capital	(000s)		0.220	0.212	0.204	0.197	0.189	0.284	0.282	0.280	0.279	0.278	0.291	0.291	0.248	0.257	0.266	0.275	0.286	0.296	0.308	0.320	0.333	0.346	0.360	0.375	0.391	
6	Gross Total Tariff	(000s)		10.696	10.322	9.949	9.576	9.202	10.961	10.709	10.465	10.228	9.998	10.427	10.214	7.876	8.056	8.247	8.448	8.661	8.885	9.123	9.374	9.640	9.921	10.218	10.532	10.864	

Levilled Tariff for the period (Per unit cost)

S.No.	Particulars	Units	Yrs -->	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	
1	O&M Expn Cost	Rs./kWh		-	-	-	-	-	1.448	1.531	1.619	1.711	1.809	1.913	2.022	2.138	2.260	2.389	2.526	2.670	2.823	2.985	3.155	3.336	3.527	3.728	3.942	4.167	
2	Depreciation	Rs./kWh		2.205	2.205	2.205	2.205	2.205	2.205	2.205	2.205	2.205	2.205	2.205	2.205	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.582	0.582	
3	Int. on Debt	Rs./kWh		3.001	2.740	2.479	2.218	1.957	1.696	1.435	1.174	0.913	0.652	0.391	0.130	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	Return on Equity	Rs./kWh		2.269	2.269	2.269	2.269	2.269	2.269	2.269	2.269	2.269	2.269	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723	2.723
5	Int. on W/Capital	Rs./kWh		0.157	0.151	0.146	0.140	0.135	0.202	0.201	0.200	0.199	0.199	0.208	0.208	0.177	0.183	0.190	0.197	0.204	0.211	0.220	0.228	0.237	0.247	0.257	0.268	0.279	
6	Gross Total of Tariff	Rs./kWh		7.631	7.365	7.098	6.832	6.565	7.820	7.641	7.466	7.297	7.134	7.439	7.288	5.620	5.748	5.884	6.027	6.179	6.340	6.509	6.688	6.878	7.078	7.290	7.514	7.751	
7	Disc. Factor		13.08%	8.25	1.000	0.884	0.782	0.692	0.612	0.541	0.478	0.423	0.374	0.331	0.293	0.259	0.229	0.202	0.179	0.158	0.140	0.124	0.109	0.097	0.086	0.076	0.067	0.059	0.052
8	Tariff Product			58.55	7.631	6.513	5.551	4.725	4.015	4.229	3.654	3.158	2.729	2.360	2.176	1.885	1.286	1.163	1.053	0.954	0.864	0.784	0.712	0.647	0.588	0.536	0.488	0.445	0.406
9	Levilled Tariff			7.10																									

Int. on Debt Calculation

(Amount in Thousands)

(Amount in Thousands)

S.No.	Particulars	1	2	3	4	5	6	7	8	9	10	11	12	13	
1	Opng. Balnc	12	37.10	34.01	30.92	27.83	24.73	21.64	18.55	15.46	12.37	9.28	6.18	3.09	0
2	Repayment	11.83%	3.09	3.09	3.09	3.09	3.09	3.09	3.09	3.09	3.09	3.09	3.09	3.09	0
3	Cls. Balnc		34.01	30.92	27.83	24.73	21.64	18.55	15.46	12.37	9.28	6.18	3.09	0.00	0
4	Avg. Loan		35.55	32.46	29.37	26.28	23.19	20.10	17.00	13.91	10.82	7.73	4.64	1.55	0
5	Int. on Loan/Debt		4.206	3.840	3.475	3.109	2.743	2.377	2.012	1.646	1.280	0.914	0.549	0.183	0

Tariff Order for Roof Top Solar Plants in Manipur

ANNEXURE-V

Range: 1kW-10 kW

Capacity: 1kW

S.No.	Particulars	Units	Rs. '000s
1	Capital Cost	(000s)	18.00
2	Equity @ 30% of CC	(000s)	5.40
3	Debt @ 70% of CC	(000s)	12.60

CUF Op	0
CUF Reduction	0.00% 5th year Onwards
Capital Subsidy	70%

S.No.	Particulars	Units	Yrs -->	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
1	Installed Capacity	kW		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Cap. Utilsn. Factor	%		16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
3	Gross Energy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402
4	Net Enregy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402

Interest on Working Capital workings (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn - 1 mth	(000s)		-	-	-	-	-	0.17	0.18	0.19	0.20	0.21	0.22	0.24	0.25	0.26	0.28	0.30	0.31	0.33	0.35	0.37	0.39	0.41	0.44	0.46	0.49
2	Maint. Spares as (% of O&M expn	(000s)	15%	-	-	-	-	-	0.30	0.32	0.34	0.36	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.56	0.59	0.63	0.66	0.70	0.74	0.78	0.83	0.88
3	Receivables - 2mths	(000s)		0.61	0.58	0.56	0.54	0.52	0.86	0.85	0.85	0.86	0.86	0.90	0.91	0.79	0.82	0.85	0.89	0.92	0.96	1.00	1.04	1.09	1.13	1.18	1.23	1.29
4	Total W/Cap required	(000s)		0.61	0.58	0.56	0.54	0.52	1.33	1.35	1.38	1.42	1.45	1.53	1.57	1.49	1.56	1.64	1.71	1.80	1.88	1.98	2.07	2.18	2.29	2.40	2.52	2.65
6	Interest on W/Cap	(000s)	12.33%	0.07	0.07	0.07	0.07	0.06	0.16	0.17	0.17	0.17	0.18	0.19	0.19	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.26	0.27	0.28	0.30	0.31	0.33

Tariff for Solar PV calculation (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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	
1	O&M Expn with Escl.	(000s)	5.72%	-	-	-	-	-	2.03	2.15	2.27	2.40	2.54	2.68	2.83	3.00	3.17	3.35	3.54	3.74	3.96	4.18	4.42	4.68	4.94	5.23	5.52	5.84	
2	Depreciation	(000s)	5.83%	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	
3	Int. on Debt	(000s)		1.43	1.30	1.18	1.06	0.93	0.81	0.68	0.56	0.43	0.31	0.19	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	Return on Equity	(000s)		1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
5	Int. on W/Capital	(000s)		0.07	0.07	0.07	0.07	0.06	0.16	0.17	0.17	0.17	0.18	0.19	0.19	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.26	0.27	0.28	0.30	0.31	0.33	
6	Gross Total of Tariff	(000s)		3.63	3.51	3.38	3.25	3.13	5.13	5.13	5.13	5.14	5.15	5.40	5.43	4.75	4.93	5.12	5.32	5.54	5.76	6.00	6.25	6.52	6.80	7.09	7.41	7.74	

Levelised Tariff for the period (Per unit cost)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn Cost	Rs./kWh		-	-	-	-	-	1.45	1.53	1.62	1.71	1.81	1.91	2.02	2.14	2.26	2.39	2.53	2.67	2.82	2.98	3.16	3.34	3.53	3.73	3.94	4.17
2	Depreciation	Rs./kWh		0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
3	Int. on Debt	Rs./kWh		1.02	0.93	0.84	0.75	0.66	0.58	0.49	0.40	0.31	0.22	0.13	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Return on Equity	Rs./kWh		0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
5	Int. on W/Capital	Rs./kWh		0.05	0.05	0.05	0.05	0.05	0.12	0.12	0.12	0.12	0.13	0.13	0.14	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23	0.23
6	Gross Total of Tariff	Rs./kWh		2.59	2.50	2.41	2.32	2.23	3.66	3.66	3.66	3.67	3.68	3.85	3.88	3.39	3.52	3.66	3.80	3.95	4.11	4.28	4.46	4.65	4.85	5.06	5.29	5.52
7	Disc. Factor		13.08%	1.00	0.88	0.78	0.69	0.61	0.54	0.48	0.42	0.37	0.33	0.29	0.26	0.23	0.20	0.18	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05
8	Tariff Product		26.06	2.59	2.21	1.89	1.60	1.36	1.98	1.75	1.55	1.37	1.22	1.13	1.00	0.78	0.71	0.65	0.60	0.55	0.51	0.47	0.43	0.40	0.37	0.34	0.31	0.29
9	Levelised Tariff			3.16																								

Int. on Debt Calculation

S.No.	Particulars	Units	(Amount in Thousands)	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Opng. Balnc		12	12.60	11.55	10.50	9.45	8.40	7.35	6.30	5.25	4.20	3.15	2.10	1.05	0
2	Repayment		11.83%	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	0
3	Cls. Balnc			11.55	10.50	9.45	8.40	7.35	6.30	5.25	4.20	3.15	2.10	1.05	0.00	0
4	Avg. Loan			12.08	11.03	9.98	8.93	7.88	6.83	5.78	4.73	3.68	2.63	1.58	0.53	0
5	Int. on Loan/Debt			1.428	1.304	1.180	1.056	0.932	0.807	0.683	0.559	0.435	0.311	0.186	0.062	

Tariff Order for Roof Top Solar Plants in Manipur

ANNEXURE-VI

Range: 10kW-100 kW

Capacity: 1kW

S.No.	Particulars	Units	Rs.in 000s
1	Capital Cost	(000s)	16.50
2	Equity @ 30% of CC	(000s)	4.95
3	Debt @ 70% of CC	(000s)	11.55

CUF Of	0
CUF Reduction	0.00% 5th year Onwards

Capital Subsidy 70%

S.No.	Particulars	Units	Yrs -->	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
1	Installed Capacity	kW		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Cap. Utilsn. Factor	%		16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%	16%
3	Gross Energy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402
4	Net Enrgy	kW		1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402	1402

Interest on Working Capital workings (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn - 1 mth	(000s)		-	-	-	-	-	0.169	0.179	0.189	0.200	0.211	0.223	0.236	0.250	0.264	0.279	0.295	0.312	0.330	0.349	0.369	0.390	0.412	0.435	0.460	0.487
2	Maint. Spares as (%) of O&M expn	(000s)	15%	-	-	-	-	-	0.304	0.322	0.340	0.360	0.380	0.402	0.425	0.449	0.475	0.502	0.531	0.561	0.594	0.627	0.663	0.701	0.741	0.784	0.829	0.876
3	Receivables - 2mths	(000s)		0.555	0.536	0.516	0.497	0.477	0.813	0.814	0.816	0.820	0.824	0.864	0.872	0.770	0.800	0.832	0.865	0.901	0.938	0.978	1.020	1.064	1.111	1.160	1.212	1.268
4	Total W/Cap required	(000s)		0.555	0.536	0.516	0.497	0.477	1.287	1.315	1.346	1.379	1.416	1.490	1.533	1.469	1.539	1.613	1.691	1.774	1.861	1.954	2.051	2.155	2.264	2.379	2.502	2.631
6	Interest on W/Cap	(000s)	12.33%	0.068	0.066	0.064	0.061	0.059	0.159	0.162	0.166	0.170	0.175	0.184	0.189	0.181	0.190	0.199	0.209	0.219	0.230	0.241	0.253	0.266	0.279	0.293	0.308	0.324

Tariff for Solar PV calculation (Amount in Thousands)

S.No.	Particulars	Units	Yrs -->	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	
1	O&M Expn with Escl.	(000s)	5.72%	-	-	-	-	-	2.03	2.15	2.27	2.40	2.54	2.68	2.83	3.00	3.17	3.35	3.54	3.74	3.96	4.18	4.42	4.68	4.94	5.23	5.52	5.84	
2	Depreciation	(000s)	5.83%	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
3	Int. on Debt	(000s)		1.31	1.20	1.08	0.97	0.85	0.74	0.63	0.51	0.40	0.28	0.17	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	Return on Equity	(000s)		0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
5	Int. on W/Capital	(000s)		0.07	0.07	0.06	0.06	0.06	0.16	0.16	0.17	0.17	0.17	0.18	0.19	0.18	0.19	0.20	0.21	0.22	0.23	0.24	0.25	0.27	0.28	0.29	0.31	0.32	
6	Gross Total Tariff	(000s)		3.33	3.21	3.10	2.98	2.86	4.88	4.89	4.90	4.92	4.95	5.19	5.23	4.62	4.80	4.99	5.19	5.40	5.63	5.87	6.12	6.38	6.66	6.96	7.27	7.61	

Levelised Tariff for the period (Per unit cost)

S.No.	Particulars	Units	Yrs -->	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
1	O&M Expn Cost	Rs./kWh		-	-	-	-	-	1.45	1.53	1.62	1.71	1.81	1.91	2.02	2.14	2.26	2.39	2.53	2.67	2.82	2.98	3.16	3.34	3.53	3.73	3.94	4.17
2	Depreciation	Rs./kWh		0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
3	Int. on Debt	Rs./kWh		0.93	0.85	0.77	0.69	0.61	0.53	0.45	0.37	0.28	0.20	0.12	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Return on Equity	Rs./kWh		0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
5	Int. on W/Capital	Rs./kWh		0.05	0.05	0.05	0.04	0.04	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.14	0.14	0.15	0.16	0.16	0.17	0.18	0.19	0.20	0.21	0.22	0.23
6	Gross Total of Tariff	Rs./kWh		2.38	2.29	2.21	2.13	2.04	3.48	3.49	3.50	3.51	3.53	3.70	3.73	3.30	3.42	3.56	3.70	3.86	4.02	4.19	4.36	4.55	4.75	4.97	5.19	5.43
7	Disc. Factor		13.08%	8.25	1.00	0.88	0.78	0.69	0.61	0.54	0.48	0.42	0.37	0.33	0.29	0.26	0.23	0.20	0.18	0.16	0.14	0.12	0.11	0.10	0.09	0.08	0.07	0.06
8	Tariff Product			24.67	2.38	2.03	1.73	1.47	1.25	1.88	1.67	1.48	1.31	1.17	1.08	0.97	0.75	0.69	0.64	0.59	0.54	0.50	0.46	0.42	0.39	0.36	0.33	0.31
9	Levelised Tariff			2.99																								

Int. on Debt Calculation

S.No.	Particulars	(Amount in Thousands)										(Amount in Thousands)			
		1	2	3	4	5	6	7	8	9	10	11	12	13	
1	Opng. Balnc	12	11.55	10.59	9.63	8.66	7.70	6.74	5.78	4.81	3.85	2.89	1.93	0.96	-0
2	Repayment	11.83%	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	-0
3	Cls. Balnc		10.59	9.63	8.66	7.70	6.74	5.78	4.81	3.85	2.89	1.93	0.96	0.00	
4	Avg. Loan		11.07	10.11	9.14	8.18	7.22	6.26	5.29	4.33	3.37	2.41	1.44	0.48	-0
5	Int. on Loan/Debt		1.309	1.196	1.082	0.968	0.854	0.740	0.626	0.512	0.399	0.285	0.171	0.057	

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