

Unofficial GIZ Translation

of the

ERC Rules and Regulation

on Thailand's

Solar Rooftop Programme

Original and binding legal documents:

<http://www.ratchakitcha.soc.go.th/DATA/PDF/2556/E/111/1.PDF>

<http://www.erc.or.th/ERCWeb2/Front/StaticPage/StaticPage.aspx?p=200&Tag=SolarRooftop>

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Regulation of the Energy Regulatory Commission (ERC)
on
Power Purchase from Solar PV Rooftop 2013

By virtue of Section 11(4) of the Energy Industry Act 2007 which contains certain provisions restricting the rights and liberty of an individual set forth in of Section 29, conjoined with Section 33, Section 42 and Section 43 of the Constitutional of the Royal Kingdom of Thailand, which was endorsed in the enactment of this law, the Energy Regulatory Commission establish a regulation regarding power purchase from solar PV rooftop as following:

Section 1 This Regulation is called the *“power purchase from solar PV rooftop, B.E. 2556”*

Section 2 This Regulation shall come into force as from the day following the date of its publication in the Government Gazette.

Section 3 This Regulation is applicable to a purchase of power from very small power producer (VSPP) using solar PV rooftop system. This Order does not enforce VSPP who produces electricity from other renewable energy resources. The latter is subjected to the other power purchase regulation.

Section 4 In this Regulation,

“VSPP Applicant” or *“VSPP”* means a person who intends to generate electricity from a solar PV rooftop system and sell that power to the Power Distributor, with a sale capacity of up to 10 MW;

“ERC” means the Energy Regulatory Commission;

“ERC Office” means the Energy Regulatory Commission Office;

“Power Distributor” means Provincial Electricity Authority (PEA) and Metropolitan Electricity Authority (MEA);

“Solar PV Rooftop” means generation of electricity from solar source by utilizing photovoltaic panel installed on the roof, deck, or any part of building;

“Building” means a building according to the Building Act in which persons can reside or utilize. The definition does not include wall, fence, banner or banner’s structure, parking area, U-turn area, access way for vehicle, or likewise structure;

“Residence” means a building owned by electricity user type 1 (residence) according to the electricity tariff announcement of the Power Distributor;

“Business or industry” means a building owned by electricity user type 2 (small enterprise), or type 3 (medium enterprise), or type 4 (large enterprise), or type 5 (special enterprise) according to the electricity tariff announcement of the Power Distributor;

“*Power Network Regulation*” means “Regulation of PEA regarding power network connection code, power network utilization code, and power network operation code” and “Regulation of MEA regarding power network connection code, power network utilization code, and power network operation code”;

“*Power Purchase Agreement (PPA)*” means a written agreement between qualified VSPP and the Power Distributor;

“*Point of Power Purchase*” means a location in which a power meter, measuring electricity flow from VSPP to the Power Distributor, is installed;

“*Feed-in Tariff (FIT)*” means a purchasing tariff of solar PV rooftop according to government policy. FIT will be announced from time to time;

“*Installed Capacity*” means a combination of installed capacity of photovoltaic panels at Standard Test Condition (STC), which share the same electrical circuit, as specified in the PPA;

“*SCOD*” means scheduled commercial operation date;

“*COD*” means commercial operation date.

Section 5 The chairman of ERC is an acting person of the regulation and holds a final decision for this Regulation.

Division 1

General Provision

Section 6 The Power Distributor is an electricity purchaser from the VSPP, who produces electricity by using solar PV rooftop. The purchase is according to criteria, procedures, and conditions set forth by this Regulation.

Section 7 The Power Distributor purchases electricity from the VSPP at the Point of Power Purchase according to area and quantity in which specified in each power purchase announcement.

Section 8 The VSPP Applicant, after submit a form of power sale, is not allowed to change any information regarding installed capacity, sale capacity, and the Point of Power Purchase before PPA signing.

Section 9 The VSPP Applicant who intend to generate and sell power to the Power Distributor must follow a safety standards and connection standards according to the Power Network Regulation. This also include specifications of materials, equipment, and solar PV rooftop installation, which is announced in the PPA. For the sake of power system stability, the Power Distributor reserves a right to inspect or request for an inspection by VSPP, to modify VSPP’s equipment which is related to power system on the Power Distributor side as deem necessary.

Section 10 In an application, the VSPP Applicant must specify a clear SCOD. This has to be within the SCOD duration timeframe as specified in the power purchase announcement. The Power Distributor may change the SCOD as necessary.

Division 2

Procedure of Power Purchase from VSPP and Evaluation Criteria

Section 11 The purchase of power from the VSPP must be done through selection process. This is based on a sequence of complete document submission.¹ The evaluation must be according to qualifications, criteria, procedures, and conditions which will be specified in each power purchase announcement.

Section 12 The ERC will announce the power purchase from time to time. The criteria, procedure and condition shall be specified as following:

- (1) Overall purchase quantity, including specified area in which power system is capable to absorb a power produced from VSPP;
- (2) Start and end date of application document submission, duration timeframe for evaluation by the Power Distributor;
- (3) Feed-in Tariff and SCOD duration timeframe, applicable period of FiT;
- (4) Application fee, cost of connection to the power network, equipment inspection and other related fees;
- (5) Place of document submission;
- (6) Other related criteria and conditions.

Section 13 The Power Distributor, who has authorities in respective power network area, evaluates the application according to following criteria:

- (1) Compliance to specified criteria and conditions defined in the power purchase announcement, completeness of document submission, details of application documents, and connection to power network;
- (2) Date and time, in which complete application documents are received. This is considered as a major aspect;
- (3) VSPP applications will be put into sequence according to the date of complete document submission. This is done until an accumulated proposed power sale is equal to the purchasing quota. Only those applications are considered as qualified for PPA.

Section 14 The Power Distributor announces the list of qualified VSPP, so that VSPP can sign the PPA within the timeframe as specified in the power purchase announcement.

¹ Remark by Translator: "First-come, first-served" principle

In case the Power Distributor agree to purchase, the Power Distributor shall inform VSPP regarding related fees and expenses, VSPP must pay the fees and expenses within specified timeframe.

Division 3

Criteria and Method of Power Purchase Calculation

Section 15 Power purchase quantity shall be an actual power supply in respective month. This shall be measured by the power meter as specified by the Power Distributor. In case the VSPP sell more electricity to the Power Distributor than what was specified in the PPA, the Power Distributor will not pay the excess portion to the VSPP in that month.

Section 16 Power purchase tariff, in which the Power Distributor has pay to the VSPP each month, is according to the FiT as specified in the power purchase announcement.

Section 17 Value of power purchase in each month is calculated by multiplying the power purchase quantity as specified in Section 15 with FiT as specified in each power purchase announcement.

Division 4

Connection and Equipment Inspection Fees

Section 18 Connection and equipment inspection fees: VSPP is obliged to pay any fees as specified in each power purchase announcement. The payment must be made before the Power Utility commence a connection to its power network.

Section 19 Damage of power network: VSPP and the Power Utility must install protective devices according to the Power Network Regulation being enforced at that time.

In case of a damage resulted from failure of electrical equipment or other causes within responsibility from a party, that party will be held responsible for such damage.

Division 5

Force Majeure

Section 20 "Force Majeure" means any event the happening or pernicious result of which could not be prevented even though a person against whom it happened or threatened to happen were to take such appropriate care as might be expected from him in his situation and in such condition. The force majeure includes one or combination of following:

- (1) Government actions such as change of energy policy or law which causes the VSPP/the Power Distributor unable to follow any power purchase regulation;
- (2) Confinement and war-like actions of enemy regardless a declaration has been made or not;
- (3) Revolution, coup d'état, riot, espionage, sabotage, work strike, job closure according to the Labour Act, rights diminishing, accident, earthquake, thunderstorm, fire, flooding, epidemic, unusual violent weather condition, bombing;
- (4) Interference in power distribution network caused by accident on power distribution system or related equipment;
- (5) Seizure of VSPP's plant, assets, shares, or any rights by any government institutions, government actions which critically impacts the VSPP or its operation according to PPA.

Division 6

Power Purchase Agreement

Section 21 Prior to PPA signing, the VSPP must read and understand conditions and procedures as specified in regulations, announcements, and PPA, including related documents to the PPA. The VSPP must comply to all specified conditions and must not modify or change the installed capacity, sale capacity, Point of Power Purchase, and technology of power generation after PPA signing.

Section 22 In case the VSPP want to transfer rights and operation duties as specified in the PPA, Approval from the Power Distributor is mandatory. The Power Distributor must also notify ERC.

Section 23 In case the VSPP is unable to supply electricity to the distribution network within the defined SCOD as per the PPA, the Power Distributor and the VSPP must strictly follow requirements set forth in the PPA.

Division 7

Settlement of Dispute

Section 24 Problems caused by compliance to this regulation and the PPA

- (1) Problems caused by compliance to this regulation

VSPP who encounters any problems arising by performing in compliance with this Regulation shall notify ERC. The written complaint shall be submitted to the chairman of the ERC, ERC Office, No. 319, Jamjuree Square Building, 19th Floor, Phrayathai Road, Pathumwan, Bangkok 10330

In case there is an appropriate necessity for dispute settlement in problems arising from compliance to this Regulation, the ERC shall be the one who rules the dispute settlement. The decision of ERC is final.

- (2) Problems caused by compliance to the PPA

VSPP who encounters any problems arising by performing in compliance with the PPA shall notify ERC. The written complaint shall be submitted to the chairman of the ERC as per the address given in Section 24(1).

In case there is an appropriate necessity for dispute settlement in problems arising from compliance to this Regulation, the ERC shall be the one who rules the dispute settlement.

In case the VSPP does not agree with the ERC decision, the court of Thailand shall rule the final settlement.

Announced on 30th August 2013

Direk Dalawansiri

Chairman of the Energy Regulatory Commission

Notification of the Energy Regulatory Commission

on

Power Purchase from Solar PV Rooftop

Referring to the Cabinet Meeting on 13th August 2013, the Cabinet made an approval, according to the National Energy Policy Committee (NEPC)'s resolutions of the Meeting No. 2/2013 (No. 145) held on 16th July 2013, on power purchase from solar PV rooftop at the feed-in tariff (FiT).

By virtue of Section 11(4) of the Energy Industry Act B.E. 2556 (2013) and the Regulation of the Energy Regulatory Commission on Power Purchase from Solar PV Rooftop B.E. 2556 (2013) dated 30th August 2013, the Energy Regulatory Commission (ERC) would like to make an announcement inviting those who are interested in selling electricity generated from solar PV rooftop to submit their proposals as follows:

Clause 1 The Power Distributor shall purchase electricity generated from solar PV rooftop, where the seller's Commercial Operation Date (COD) falls within 31st December 2013, at the quantity generated at the overall installed capacity of 200 MW_p subject to the following:

1.1 Building types and overall installed capacity

Building Type	Installed Capacity (System Size)	Overall Installed Capacity (Quota/Target)
(1) Residence	Not exceeding 10 kW _p	100 MW _p
(2) Small Enterprise	10 – 250 kW _p	100 MW _p
(3) Medium-Large Enterprise/Industry	250 – 1,000 MW _p	

“MW_p” means the maximum megawatt of photovoltaic panel at Standard Test Condition.

“kW_p” means the maximum kilowatt of photovoltaic panel at Standard Test Condition.

1.2 Purchased quantity in different areas under jurisdictions of the Power Distributor

Area/Jurisdiction	Purchased Quantity (MW _p)	
	Residence	Small Enterprise and Medium-Large Business/ Industry
(1) Provincial Electricity Authority (PEA) Total	40	40
3 provinces namely Bangkok, Nonthaburi and Samut Prakarn	40	40
(2) Metropolitan Electricity Authority (MEA) Total	60	60
(2.1) Northern Region composed of 20 provinces:		15
(1) Covering area of 6 provinces: Chiang Mai, Chiang Rai, Mae Hong Son, Lamphoon, Lampang, and Phayao	5	
(2) Covering area of 8 provinces: Phitsanulok, Uttaradit, Prae, Kamphaeng Phet, Sukhothai, Tak, Phichit, and Nan	5	
(3) Covering area of 6 provinces: Lopburi, Nakhon Sawan, Phetchabun, Singburi, Chainat, and Uthai Thani	5	

Area/Jurisdiction	Purchase Quantity (MW _p)	
	Residence	Small Enterprise and Medium-Large Business/ Industry
<p>(2.2) Northeastern Region</p> <p>composed of 20 provinces:</p> <p>(1) Covering area of 8 provinces: Udon Thani, Nong Khai, Nong Bua Lam Phu, Sakon Nakhon, Nakhon Phanom, Khon Kaen, Loei, and Bungkan</p> <p>(2) Covering area of 8 provinces: Ubon Ratchathani, Yasothon, Amnat Charoen, Roi Et, Sisaket, Kalasin, Maha Sarakham, and Mukdahan</p> <p>(3) Covering area of 4 provinces: Nakhon Ratchasima, Chaiyaphum, Surin, and Buri Ram</p>	5	15
<p>(2.3) Central Region composed of 20 provinces and 1 district:</p> <p>(1) Covering area of 7 provinces: Phra Nakhorn Si Ayutthaya, Pathum Thani, Saraburi, Angthong, Prachinburi, Nakhon Nayok, and Sa Kaeo</p> <p>(2) Covering area of 5 provinces: Chonburi, Rayong, Chanthaburi, Trat, and Chachoengsao</p> <p>(3) Covering area of 4 provinces and 1 district: Nakhon Pathom, Suphan Buri, Kanchanaburi,</p>	5	15

Area/Jurisdiction	Purchase Quantity (MW _p)	
	Residence	Small Enterprise and Medium-Large Business/ Industry
Samut Sakhon, and Ban Pong District , Ratchaburi Province		
(2.4) Southern Region composed of 18 provinces: (1) Covering area of 6 provinces: Phetchaburi, Ratchaburi (except Ban Pong District), Samut Songkhram, Prachuap Khiri Khan, Chumphon, and Ranong (2) Covering area of 6 provinces: Nakhon Si Thammarat, Surat Thani, Phuket, Trang, Krabi, and Phang Nga (3) Covering area of 6 provinces: Yala, Pattani, Songkhla, Narathiwat, Phatthalung, and Satun	5 5 5	15

In the case where there is restriction on power network system, the Power Distributor shall be able to make appropriate change on the quantity and point of power purchase specified above.

Clause 2 A person who intends to sell electricity to the Power Distributor shall have the following qualifications:

2.1 Such person must be a building owner or obtain consent from the building owner or have lease agreement where such building must have never been installed any photovoltaic panel.

2.2 In the case where such person is a juristic person, business objectives of generating and selling electricity must be indicated on the certificate of juristic person's registration.

2.3 Such person must not be a ministry, bureau, department, state enterprise, local administrative organization, or government body having the same status as department, government body under the jurisdiction of the Parliament, court, or other government agency.

2.4 The building with installed photovoltaic panel must already have the appropriate power meter in accordance with type of power user set by the Power Distributor which is consistent with building type described in Clause 1 and that the building must not belong to those listed in 2.3

Clause 3 A person who intends to sell electricity to the Power Distributor shall submit the Application for Sale of Electricity and System Interconnection as indicated in Annex 1 from Monday 23rd September 2013 to Friday 11th October 2013 during 09:00 – 15:00 hr at a corresponding office of the Power Distributor as indicated in Annex 2.

Where a person intending to sell electricity is in the residence group, such person can file up to 10 sale of electricity application forms for each application submission. For a person intending to sell electricity who is in business or industry group, not more than 1 sale of electricity application form must be filed for each application submission.

To be in order, the Power Distributor shall manage upon the received applications in a manner as deemed necessary and appropriate.

Clause 4 Each sale of electricity application form must have the following installed capacity:

4.1 In case of the residence group, the installed capacity of photovoltaic panel must not exceed 10 kW_p.

4.2 In case of the business or industry group, the installed capacity of photovoltaic panel must be more than 10 kW_p but not exceeding 250 kW_p for small enterprise, and not exceeding 1000 kW_p for medium-large enterprise/industry.

4.3 The photovoltaic panels must use the same circuit and have the same point of power purchase.

Clause 5 The Power Distributor shall sort the sale of electricity application forms in accordance with the date and time of receiving the complete documents.

In the case where an applicant is a very small power producer (VSPP), the Power Distributor shall put the date and time on the application form after checking the completeness of the application and documents.

In case where it is found that application form and documents are incomplete, the Power Distributor shall notify the VSPP applicant. And the VSPP applicant shall promptly submit additional information within the filing dates and time indicated in Clause 3. The Power Distributor shall deem the date and time of receiving the application to be the latest date and time upon the receipt of the additional information and documents. The Power Distributor shall not accept any additional documents after the closing date of filing period and it is deemed that the VSPP application does not intend to submit any additional documents.

Clause 6 Power purchase tariff paid to a person who intends to generate electricity from a solar PV rooftop system must be in accordance with the Feed-in Tariff (FiT) as shown in the following table for the duration of 25 years starting from the scheduled commercial operation date (SCOD)

Building Type	Installed Capacity	FIT
(1) Residence	Not exceeding 10 kW _p	6.96 baht/unit
(2) Small Enterprise	More than 10 – 250 kW _p	6.55 baht/unit
(3) Medium-Large Enterprise/Industry	More than 250 – 1,000 kW _p	6.16 baht/unit

Clause 7 Expenses incurred from power system connection, system and equipment inspection, and other relevant expenses must be paid at the rates provided in [Annex 3](#).

Clause 8 The Power Distributor shall start announcing the selected sale of electricity applicants from Monday 14th October 2013 onwards.

Clause 9 A selected applicant from Clause 8 shall contact the Power Distributor in order to be informed of relevant conditions and expenses prior the signing of a power purchase agreement (PPA). The selected applicant shall sign the PPA, as provided in [Annex 4](#), without delay within the time provided by the Power Distributor.

Clause 10 The signer of the PPA shall supply electricity to the distribution network within the defined SCOD as specified in the PPA which must be before 31 December 2013.

Clause 11 Prior to the COD, the sale of electricity applicant shall provide the license as required by law to the Power Distributor who is power purchase contracting party.

Clause 12 The VSPP shall install equipment and power generating system which have specifications of materials, equipment, and solar PV rooftop installation as provided in Annex ([Annex 5](#)); and connect to the power network system as in accordance with the Power Network Regulation ([Annex 6](#)) where additional equipment required in the power network connection must be provided by the sale of electricity applicant.

A person qualified to install solar PV rooftop system should be a person certified by and registered with the Department of Alternative Energy Development and Efficiency or a person with relevant license for professional practice (Annex 7)

Clause 13 The VSPP who generates electricity from the solar PV rooftop should have an appropriate warranty on power generating system from the third party.

Clause 14 The signer of the PPA must strictly follow requirements and other conditions set forth in the PPA. It is prohibited to sell electricity generated from power generation sources other than solar energy as in accordance with the PPA. In case where it is found that electricity generated from power generation sources other than solar energy was supplied, the PPA shall be deemed terminated. The person violating the PPA shall be fined at the rate provided in the PPA and pay back the full amount of charges received from power sale to the Power Distributor from the COD.

Announced on 6th September 2013

Direk Dalawansiri

Chairman of the Energy Regulatory Commission

Annexes

- 1. Application for Sale of Electricity and System Interconnection**
 - 1.1 Application for Sale of Electricity and System Interconnection with Metropolitan Electricity Authority (MEA)
 - 1.2 Application for Sale of Electricity and System Interconnection with Provincial Electricity Authority (PEA)
- 2. Receiving Office Information for Filing Application for Sale of Electricity and System Interconnection**
- 3. Expenses on Power Network Connection, Equipment Inspection, and Other Relevant Expenses**
- 4. Power Purchase Agreement**
 - 4.1 Power Purchase Agreement done with Metropolitan Electricity Authority (MEA)
 - 4.2 Power Purchase Agreement done with Provincial Electricity Authority (PEA)
- 5. Specifications of Materials, Equipment, and Solar PV Rooftop Installation**
- 6. Requirements on Power Network System Connection**
 - 6.1 Requirements on Power Network System Connection with Metropolitan Electricity Authority (MEA)
 - 6.2 Requirements on Power Network System Connection with Provincial Electricity Authority (PEA)
- 7. Registration Criteria to be listed as Recommended Solar PV Rooftop Installers and Invitation to File Registration Form**

Annex 1.1**Metropolitan Electricity Authority****Application for Sale of Electricity****Generated from Solar PV Rooftop****for Very Small Power Producer (VSPP)**

The application for sale of electricity and system interconnection for VSPP using solar PV rooftop to supply power to the Metropolitan Electricity Authority (MEA) system.

Please ✓ where it is appropriate

Section 1: Applicant Information of the person intending to sell electricity and installing building**1.1 Building Type where Photovoltaic Panel will be installed**

Power User Type 1: Residence

Residence (not exceeding 10 kW_p) with Installed Capacity _____ kW_p

Power User Type 2, 3, 4, and 5

Small Enterprise (more than 10 – 250 kW_p) with Installed Capacity _____ kW_p

Medium-Large Enterprise (more than 250– 1,000 kW_p) with Installed Capacity _____ kW_p

Remarks: Installed Capacity means a combination of installed capacity of photovoltaic panels at Standard Test Condition (STC), which share the same electrical circuit, as specified in the Power Purchase Agreement (PPA).

1.2 I, hereby, submit the Application in the capacity as

Individual

I (Mr./Mrs./Miss) _____ Surname _____ Age _____

Nationality _____ Personal Identification Number _____ Address _____

Province _____ Post Code _____

Telephone _____ Mobile _____ Email _____

who is building owner building tenure/ obtaining consent from the owner**Building where Photovoltaic Panel will be installed**

Address _____

Province _____ Post Code _____

Meter No. _____ Contract Account No. _____

Name of Meter's Owner _____

and authorise (Mr./Mrs./Miss) _____ Surname _____

Telephone _____ Mobile _____ Email _____

to coordinate on my behalf.

 Juristic Person

Name of Business or Company _____

Headquarters Location _____

Telephone _____ Fax _____

Business or Company Owner or Authorised Representatives

Name-Surname _____

Name-Surname _____

Name-Surname _____

who is building owner building tenure/ obtaining consent from the owner

Building where Photovoltaic Panel will be installed

Address _____

Province _____ Post Code _____

Meter No. _____ Contract Account No. _____

Name of Meter's Owner _____

and authorise (Mr./Mrs./Miss) _____ Surname _____

Telephone _____ Mobile _____ Email _____

to coordinate on my behalf.

Section 2: Technical Information and Specifications of Power Generating System

2.1 Total power generated/SCOD

- 1) Installed Capacity _____ kW_p at Standard Test Condition
- 2) SCOD _____

Voltage 230/400 V from 12 kV onward

2.2 Details of power generating system

- 1) Photovoltaic Panel

Manufacturer _____ Model Name _____ Number of unit(s) _____

Type Crystalline Solar Cells Thin Film Solar Cells

Others _____

Generating Capacity per Panel (Watts) _____ Size per Panel (square meters) _____

Total Installation Area (square meters) _____

- 2) Inverter

Manufacturer _____ Model Name _____ Number of unit(s) _____

Power Rating (kW per inverter) _____ AC Rating (Volt) _____

Phase (single or 3 phase inverter) _____ Firmware Version _____

having electrical specification as specified in MEA's System Interconnection requirements (Annex 6).

In case where there is more than 1 model of inverter, complete details must be attached.

Remarks * In case where manufacturer or model in 1) and 2) is to be changed, such change may be proceeded before signing the PPA.

3) Transformer (if any) with capacity (kVA) _____

Section 3 Applicant Signature

I hereby certify that, all provided information about solar PV rooftop and interconnection equipment and materials is true and correct.

Signature _____ Date _____

(.....)

Applicant*

Remarks* In case of juristic person, there must be signatures of all authorised representatives provided and company seal must be affixed.

Remarks: Applicant must send an original copy of the PPA and supporting documents to MEA together with the same set of document in CD ROM or Flash Dive.

Annex

Application for Sale of Electricity Generated from Solar PV Rooftop for Very Small Power Producer (VSPP)

1. Details of Applicant and Buiding to be installed

1.1 Individual

- 1) A copy of Applicant's Personal Identification Card
- 2) In case where authorised person submits the Application
 - 2.1) Letter of Authorisation (stamp duties affixed)
 - 2.2) A copy of authorised person's Personal Identification Card
- 3) A copy of electricity bill of the building to be installed photovoltaic pane or evidence showing power meter number
- 4) In case where the Applicant is the building owner
 - 4.1) Evidence of ownership
- 5) In case where the Applicant is not the building owner
 - 5.1) Consent from the owner or lease agreement
 - 5.2) Evidence of ownership
 - 5.3) A copy of the building owner's Personal Identification Card

1.2 Juristic Person

- 1) A copy of Personal Identification Card of the owner of business or company intending to sell electricity or its authorised representatives as indicated in the Certificate of Juristic Person Registration
- 2) The Certificate of Juristic Person Registration (issued within last 6 months) where one of the business objectives must be to generate and supply electricity
- 3) Letter of Authorisation (stamp duties affixed) where the authorised person submits the Application

- 4) A copy of authorised person's Personal Identification Card
- 5) A copy of electricity bill of the building to be installed photovoltaic pane or evidence showing power meter number
- 6) In case where the Applicant is the building owner
 - 6.1) Evidence of ownership
- 7) In case where the Applicant is not the building owner
 - 7.1) Consent from the owner or lease agreement
 - 7.2) Evidence of ownership

2. Specifications and Technical Information of Power Generating System and General Technical Information

- 2.1 Documents showing details of photovoltaic panel's specifications
- 2.2 Documents showing details of inverter's specifications
- 2.3 Datasheet of transformer which is connected to inverter (Rated Power (MVA), HV/LV Rated Voltage (kV), Vector Group, Frequency, Maximum short circuit rating (kA))
- 2.4 Plan showing photovoltaic panel installed location
- 2.5 Single Line Diagramme showing configuration and interconnection of all equipment in details where the Diagramme must be certified by an engineer and a copy of valid license for professional practice

Annex 1.2

Provincial Electricity Authority

Application for Sale of Electricity
Generated from Solar PV Rooftop
for Very Small Power Producer (VSPP)

The application for sale of electricity and system interconnection for VSPP using solar PV rooftop to supply power to the Provincial Electricity Authority (PEA) system.

Please ✓ where it is appropriate

Section 1: Applicant Information of the person intending to sell electricity and installing building**1.3 Building Type where Photovoltaic Panel will be installed**

Power User Type 1: Residence

Residence (not exceeding 10 kW_p) with Installed Capacity _____ kW_p

Power User Type 2, 3, 4, and 5

Small Enterprise (more than 10 – 250 kW_p) with Installed Capacity _____ kW_p

Medium-Large Enterprise (more than 250– 1,000 kW_p) with Installed Capacity _____ kW_p

Remarks: Installed Capacity means a combination of installed capacity of photovoltaic panels at Standard Test Condition (STC), which share the same electrical circuit, as specified in the Power Purchase Agreement (PPA).

1.4 I, hereby, submit the Application in the capacity as

Individual

I (Mr./Mrs./Miss) _____ Surname _____ Age _____

Nationality _____ Personal Identification Number _____ Address _____

Province _____ Post Code _____

Telephone _____ Mobile _____ Email _____

who is building owner building tenure/ obtaining consent from the owner**Building where Photovoltaic Panel will be installed**

Address _____

Province _____ Post Code _____

Meter No. _____ Contract Account No. _____

Name of Meter's Owner _____

and authorise (Mr./Mrs./Miss) _____ Surname _____

Telephone _____ Mobile _____ Email _____

to coordinate on my behalf.

 Juristic Person

Name of Business or Company _____

Headquarters Location _____

Telephone _____ Fax _____

Business or Company Owner or Authorised Representatives

Name-Surname _____

Name-Surname _____

Name-Surname _____

who is building owner building tenure/ obtaining consent from the owner

Building where Photovoltaic Panel will be installed

Address _____

Province _____ Post Code _____

Meter No. _____ Contract Account No. _____

Name of Meter's Owner _____

and authorise (Mr./Mrs./Miss) _____ Surname _____

Telephone _____ Mobile _____ Email _____

to coordinate on my behalf.

Section 2: Technical Information and Specifications of Power Generating System**2.3 Total power generated/SCOD**3) Installed Capacity _____ kW_p at Standard Test Condition

4) SCOD _____

Voltage below 400 V from 22 kV onward**2.4 Details of power generating system**

3) Photovoltaic Panel

Manufacturer _____ Model Name _____ Number of unit(s) _____

Type Crystalline Solar Cells Thin Film Solar Cells Others _____

Generating Capacity per Panel (Watts) _____

4) Inverter

Manufacturer _____ Model Name _____ Number of unit(s) _____

Power Rating (kW per inverter) _____ AC Rating (Volt) _____

In case where there is more than 1 model of inverter, complete details must be attached.

Remarks * In case where manufacturer or model in 1) and 2) is to be changed, such change may be proceeded before signing the PPA.

3) Transformer (if any) with capacity (kVA) _____

Section 3 Applicant Signature

I hereby certify that, all provided information about solar PV rooftop and interconnection equipment and materials is true and correct.

Signature _____ Date _____

(.....)

Applicant*

Remarks* In case of juristic person, there must be signatures of all authorised representatives provided and company seal must be affixed.

Remarks: Applicant must send an original copy of the PPA and supporting documents to PEA together with the same set of document in CD ROM or Flash Dive.

Annex

Application for Sale of Electricity Generated from Solar PV Rooftop for Very Small Power Producer (VSPP)

1. Details of Applicant and Building to be installed

1.1 Individual

- 1) A copy of Applicant's Personal Identification Card
- 2) In case where authorised person submits the Application
 - 2.1) Letter of Authorisation (stamp duties affixed)
 - 2.2) A copy of authorised person's Personal Identification Card
- 3) A copy of electricity bill of the building to be installed photovoltaic pane or evidence showing power meter number
- 4) In case where the Applicant is the building owner
 - 4.1) Evidence of ownership
- 5) In case where the Applicant is not the building owner
 - 5.1) Consent from the owner or lease agreement
 - 5.2) Evidence of ownership
 - 5.3) A copy of the building owner's Personal Identification Card

1.2 Juristic Person

- 1) A copy of Personal Identification Card of the owner of business or company intending to sell electricity or its authorised representatives as indicated in the Certificate of Juristic Person Registration
- 2) The Certificate of Juristic Person Registration (issued within last 6 months) where one of the business objectives must be to generate and supply electricity
- 3) Letter of Authorisation (stamp duties affixed) where the authorised person submits the Application

- 4) A copy of authorised person's Personal Identification Card
- 5) A copy of electricity bill of the building to be installed photovoltaic pane or evidence showing power meter number
- 6) In case where the Applicant is the building owner
 - 6.1) Evidence of ownership
- 7) In case where the Applicant is not the building owner
 - 7.1) Consent from the owner or lease agreement
 - 7.2) Evidence of ownership

2. Specifications and Technical Information of Power Generating System and General Technical Information

- 2.1 Documents showing details of photovoltaic panel's specifications
- 2.2 Documents showing details of inverter's specifications
- 2.3 Datasheet of transformer which is connected to inverter (Rated Power (MVA), HV/LV Rated Voltage (kV), Vector Group, Frequency, Maximum short circuit rating (kA))
- 2.4 Plan showing photovoltaic panel installed location
- 2.5 Single Line Diagramme showing configuration and interconnection of all equipment in details where the Diagramme must be certified by an engineer and a copy of valid license for professional practice

Receiving Office Information for Filing

Application for Sale of Electricity and System Interconnection

A person who intends to sell electricity must file Application for Sale of Electricity and System Interconnection to Metropolitan Electricity Authority (MEA) or Provincial Electricity Authority (PEA) with respect to jurisdiction where the building to be installed photovoltaic panel is located as follows:

2.1 Jurisdiction of Metropolitan Electricity Authority (MEA)

(1) MEA Wat Liab District

121 Chakraphet Road, Phra Nakhon, Bangkok 10200. Tel: 0-2220-5219, 0-2220-5224

(2) MEA Klong Toei District

1192 Rama 4 Road, Klong Toei, Bangkok 10110. Tel: 0-2348-5219, 0-2348-5224

(3) MEA Yannawa District

3027 Charearnkrung Road, Bangkorleam, Bangkok 10120. Tel: 0-2611-5219, 0-2611-5224

(4) MEA Samsen District

809 Samsen Road, Dusit, Bangkok 10300. Tel: 0-2242-5219, 0-2242-5224

(5) MEA Bang Khen District

476 Moo 3 Phaholyothin Road, Bang Khen, Bangkok 10220. Tel: 0-2792-5219, 0-2792-5224

(6) MEA Ladprao

88 Ramkhamheang Road, Suanluang, Bangkok 10250. Tel: Tel: 0-2716-3219, 0-2716-3224

(7) MEA Thonburi District

132/18 Soi Charansanitwong 20, Bangkok Noi, Bangkok 10700.

Tel: 0-2878-5219, 0-2878-5224

(8) MEA Radburana District

21 Rat Burana Road, Rat Burana, Bangkok 10140. Tel: 0-2877-5219, 0-2877-5224

(9) MEA Bang Kuntien

39 Soi Rama 2 Soi 60 Samaedam, Bang Khun Tien, Bangkok 10150.

Tel: 0-2841-5219, 0-2841-5224

(10) MEA Nonthaburi District

285 Tiwanon Road, Muang, Nonthaburi 11000. Tel: 0-2902-5219, 0-2902-5224

(11) MEA Bang Yai District

38/2 Moo 10 Bangkloy-Sai Noi Road, Bang Yai, Nonthaburi 11140.

Tel: 0-2832-5219, 0-2832-5224

(12) MEA Bang Bua Thong District

13/14 Moo 4 Kanchanapisek Road, Bang Bua Thong, Nonthaburi 11110.

Tel: 0-2834-3219, 0-2834-3224

(13) MEA Bang Kapi District

88 Ramkhamheang Road, Suanluang, Bangkok 10250. Tel: 0-2725-5219, 0-2725-5224

(14) MEA Samut Prakan District

386 Sukhumwit Road, Muang, Samut Prakan 10270. Tel: 0-2791-5219, 0-2791-5224

(15) MEA Bang Phle District

70/1 Moo 1 Kingkeaw Road, Bangphle, Samut Prakan 10540. Tel: 0-2769-5219, 0-2769-5224

(16) MEA Minburi District

24 Moo 13 Suwinthawong Road, Minburi, Bangkok 10510. Tel: 0-2907-5219, 0-2907-5224

(17) MEA Lat Krabang District

24 Moo 13 Suwinthawong Road, Minburi, Bangkok 10510. Tel: 0-2792-3219, 0-2792-3224

(18) MEA Prawet District

70/1 Moo 1 Kingkeaw Road, Bangphle, Samut Prakan 10540. Tel: 0-2769-3219, 0-2769-3224

2.2 Jurisdiction of Provincial Electricity Authority (PEA)**2.2.1 Residence****(1) Northern Area**

(1.1) Chiang Mai, Chiang Rai, Mae Hong Son, Lamphoon, Lampang, and Phayao

File at PEA 1 (North, Chiang Mai)

208 Chiang Mai-Lamphoon Road, Wat Ket, Muang, Chiang Mai 50000.

Tel: 0-5324-1018 Fax: 0-5330-2474

(1.2) Phitsanulok, Uttaradit, Prachin, Kamphaeng Phet, Sukhothai, Tak, Phichit, and Nan

File at PEA 2 (North, Phitsanulok)

350/9 Moo 7, Mittaphap Road, Samor Khae, Muang, Phitsanulok 65000

Tel: 0-5532-0097-99 or 0-5532-0184-88 Fax: 0-5532-0120

(1.3) Lopburi, Nakhon Sawan, Phetchabun, Singburi, Chainat, and Uthai Thani

File at PEA 3 (North, Lopburi)

13 Phaholyothin Road, Thale Chup Son, Muang, Lopburi 15000

Tel: 0-3641-1097 Fax: 0-3641-3731

(2) Northeastern Area

(2.1) Udon Thani, Nong Khai, Nong Bua Lam Phu, Sakon Nakhon, Nakhon Phanom, Khon Kaen, Loei, and Bungkan

File at PEA 1 (Northeast, Udon Thani)

123 Moo 5 Ban Nong Hua Moo, Nadee, Muang, Udon Thani 41000

Tel: 0-4222-2666 or 0-4222-1188 or 0-4222-1199 Fax: 0-4224-6306

(2.2) Ubon Ratchathani, Yasothon, Amnat Charoen, Roi Et, Sisaket, Kalasin, Maha Sarakham, and Mukdahan

File at PEA 2 (Northeast, Udon Ratchathani)

195 Moo 7 Liang Muang Road, Jaeramae, Muang, Ubon Ratchathani 34000

Tel: 0-4524-2434-6 or 0-4528-5572-4

Fax: 0-4525-5419

(2.3) Nakhon Ratchasima, Chaiyaphum, Surin, and Buri Ram

File at PEA 3 (Northeast, Nakhon Ratchasima)

3 Moo 2 Mittaphap Road, Ban Mai, Muang, Nakhon Ratchasima 30000.

Tel: 0-4421-4334-5 or 0-4421-4337-8

Fax: 0-4421-4340

(3) Central Area

(3.1) Phra Nakhorn Si Ayutthaya, Pathum Thani, Saraburi, Angthong, Prachinburi, Nakhon Nayok, and Sa Kaeo

File at PEA 1 (Central, Phra Nakhorn Si Ayutthaya)

46 Moo 6 Sai Asia Road, Huntra, Phra Nakhorn Si Ayutthaya, Phra Nakhorn Si Ayutthaya 13000

Tel: 0-3524-1142 Fax: 0-3532-3868

(3.2) Chonburi, Rayong, Chanthaburi, Trat, and Chachoengsao

File at PEA 2 (Central, Chonburi)

47/1 Moo 3, Samet, Muang, Chonburi 20000

Tel: 0-3845-5086 or 0-3845-5147 or 0-3845-5167

Fax: 0-3846-7686

(3.3) Nakhon Pathom, Suphan Buri, Kanchanaburi, Samut Sakhon, and Ban Pong District ,
Ratchaburi

File at PEA 3 (Central, Nakhon Pathom)

9/1 Moo 1, Thaiyawas, Nakhonchaisri, Nakhon Pathom 73120

Tel: 0-3433-9140-5 Fax: 0-3433-9150

(4) Southern Area

(4.1) Phetchaburi, Ratchaburi (except Ban Pong District), Samut Songkhram, Prachuap Khiri
Khan, Chumphon, and Ranong

File at PEA 1 (South, Phetchaburi)

86 Moo 5 Phetchaburi-Had Chao Samran Road, Poraiwan, Phetchaburi 76000

Tel: 0-3259-8535-43 or 0-3241-5449-51

Fax: 0-3241-5490

(4.2) Nakhon Si Thammarat, Surat Thani, Phuket, Trang, Krabi, and Phang Nga

File at PEA 2 (South, Nakhon Si Thammarat)

167 Moo 5 Sai Asia Road, Nasan, Praprom, Nakhon Si Thammarat 80000

Tel: 0-7537-8430-7 Fax: 0-7537-8429

(4.3) Yala, Pattani, Songkhla, Narathiwat, Phatthalung, and Satun

File at PEA 3 (South, Yala)

592/7 Yala-Pattani Road, Kaotoom, Yarung, Yala 95000

Tel:0-7326-2528-35 Fax: 0-7326-2506

2.2.2 Business or Industry

File at PEA (Head Office)

200 Ngamwongwan Road, Jatujak, Bangkok 10900.

Tel: 02-589-0100-1 or 0-2590-9733 or 0-2590-9743 or 0-2590-9753 or 0-2590-9763

Annex 3**Expenses on Power Network Connection, Equipment Inspection, and Other Relevant Expenses****1. For Residence (Electricity User Type 1)**

Item	Expensed Amount (Baht)
(1) Construction and Power Distribution System Development ^(*)	Actual Expense
(2) Meter	10,000

2. For Business or Industry (Electricity Types 2 – 5)

Item	Expensed Amount (Baht)	
	Voltage	
	Below 12 kV	From 12 kV and above
(1) Construction and Power Distribution System Development ^(*)	Actual Expense	Actual Expense
(2) Meter	15,000	100,000

Remarks: ^(*) only in the case where system development is needed to support sale of electricity.

Annex 4.1

Draft of Power Purchase Agreement between Very Small Power Producer who produces electricity by using solar PV rooftop and Metropolitan Electricity Authority (MEA)

Metropolitan Electricity Authority

The Power Purchase Agreement No.....

Under the Notification of the Energy Regulatory Commission

on

Power Purchase from Solar PV Rooftop Dated

between and Metropolitan Electricity Authority

This Power Purchase Agreement (PPA) is made at the Metropolitan Electricity Authority (MEA)

on.....between

located at.....

represented by

hereafter called "Power Producer", a contracting party, and the MEA Office No. 30 Soi Chitlom, Ploenchit Road, Lumpini, Phatumwan, Bangkok 10330

represented by

hereafter called "MEA", another contracting party. Both parties agree to purchase and supply electricity subject to the following conditions:

1. Power Purchase

1.1 MEA agrees to purchase and Power Producer agrees to sell electricity generated from solar PV rooftop at the maximum sale capacity of (kW_p) (calculated from a combination of installed capacity of photovoltaic panels which share the same electrical circuit and point of power purchase and which is not exceeding maximum installed capacity specified for each type of building), with electric potential of Volt and details of power generating system as specified in the Application for Sale of Electricity and System Interconnection where the

Scheduled Commercial Operation Date (SCOD) is on This Agreement shall be terminated on (+25 years from the SCOD). In this regard, the power purchase shall start from the Commercial Operation Date (COD).

Prior to the power purchase, license as prescribed by law shall be provided to MEA.

1.2 In case where the Power Producer anticipates that power cannot be supplied within the SCOD, the Power Producer shall notify MEA promptly in writing on all aspects of preparation including construction, power station location, source of capital fund, technology, and application of licenses required by relevant law. After consideration, MEA may see as appropriate to postpone the SCOD. The SCOD shall be postponed only once and to the deemed appropriate date within the period not more than 1 month from the day following the SCOD as specified in this Agreement. However this will not have any effect on the termination date as indicated in 1.1

2. Entry into Force and Termination of the Agreement

The Agreement shall come into force on the date that both parties sign the Agreement starting from the COD until it is terminated as in the following cases:

2.1 The Power Producer sends a notice of intent to terminate the Agreement in writing to MEA;

2.2 If a contracting party fails to fulfill one of the requirements under this Agreement, another contracting party shall notify in writing such contracting party to solve the problem. Upon the receipt of such notification, if the problem is unsolved, another contracting party has the right to terminate this Agreement;

2.3 The Power Producer who already signed the Agreement must comply to all specified conditions and must not modify the overall installed capacity of photovoltaic panels and point of power purchase, as well as equipments used in power generation, without approval from MEA;

2.4 In case where the Power Producer wants to transfer rights and operation duties as specified in the Agreement, approval from MEA is mandatory. And MEA must notify the Office of the Energy Regulatory Commission (ERC).

3. Safety Standards and Power Network Connection Standards

3.1 The Power Producer and MEA must follow power purchase conditions in accordance with the following:

3.1.1 The Regulation of the Energy Regulatory Commission on Power Purchase from Solar PV Rooftop B.E. ...

3.1.2 The Notification of the Energy Regulatory Commission on Power Purchase from Solar PV Rooftop

as provided in Annexes 1 and 2 respectively.

3.2 For the sake of power system stability, MEA has the rights to inspect or request the Power Producer to inspect, or modify their power supply equipments in connection with MEA's power system as deemed necessary. In this regard, MEA reserves its rights to, at a later date, add equipments both in MEA's power distributing system and in the Power Producer's power station in order to be consistent with MEA's technical standards and power distributing forms.

3.3 It shall be deemed that the Application for Sale of Electricity from Solar PV Rooftop and documents listed in 3.1 are part of this Agreement. In case where there is a conflict between statements in Annexes and in this Agreement, the statements in this Agreement shall prevail.

3.4 A contracting party shall notify another contracting party in advance if there is any modification in its own power system which will affect protection equipments of both parties. Interconnection equipments must not be modified without sending a prior notification to MEA.

3.5 The Power Producer who is connected to MEA's power system must follow safety standards and connection standards in 3.1 and MEA's specifications of power network connection system which are currently effective.

Once there is power purchase, the Power Producer must inspect and maintain power supply equipment, control and protection system, as well as communication equipment in good condition. The Power Producer must send annually the results of its inspection to MEA for consideration. In this regard, MEA reserves its rights to send its officer to co-inspect the Power Producer's annual maintenance process in order to ensure safety and stability towards the power system, MEA's operating officers, and the Power Producer. In case where deemed as necessary, MEA has the rights to inspect or request the Power Producer to inspect, or modify their power supply equipments in connection with MEA's power system.

3.6 The Power Producer and MEA must install protection equipment, according to specifications of power network connection system which are currently effective, to prevent any damages on power network. In case there is any damage resulted from failure of electrical equipment or other causes within responsibility from a contracting party, that contracting party will be held responsible for such damage.

4. Control and Operation of Power Station

4.1 For the Power Producer with voltage of 12 kV and over must strictly follow Switching Order of MEA's Distribution Dispatching Center for the benefits of operation and maintenance except in case where it may lead to danger to life and property of any of the contracting parties.

4.2 The Power Producer shall allow MEA to enter its premises in order to install, operate, maintain, modify, and/or move electrical equipments once the owner of such premises has been notified.

4.3 It is prohibited for the Power Producer to supply electricity produced from power generating sources other than that generated from solar energy by using photovoltaic panel technology. Under this Agreement, if it is found otherwise, it shall be deemed that the Power Producer violates the Agreement resulting in the immediate termination of the Agreement. The Power Producer shall be prosecuted and not be able to claim any compensation from MEA. Penalty must be paid to MEA at the rate of 10,000 baht per kW_p of the photovoltaic panel as specified in 1.1 and all charges received from the COD on sale of electricity must be paid back to MEA.

5. Calculation of Power Purchase Quantity and Payment

5.1 Calculation of power purchase quantity and payment shall be in accordance with specifications described in Sections 15, 16, and 17 of the Regulation of the Energy Regulatory Commission on Power Purchase from Solar PV Rooftop

In any month where the Power Producer supplies more electricity to MEA than what was specified in the Agreement, MEA shall not pay the excess portion to the Power Producer.

5.2 In case where MEA fails to make payment within 30 days from the date of receiving the invoice, MEA shall allow the Power Producer to calculate interest on the remaining amount due at the rate equal to minimum

loan rate of Krungthai Bank Public Company Limited. The interest shall be calculated from the default date until the remaining amount due is settled. However the interest rate used in calculation must not be more than 15% per annum.

6. Force Majeure

6.1 “Force Majeure” means any event, the happening or pernicious result of which could not be prevented even though a person against whom it happened or threatened to happen were to taken such appropriate care as might be expected from him in his situation and in such condition. The force majeure includes on or combination of the following:

(1) Government actions such as change of energy policy or law which causes a contracting party unable to follow any power purchase regulation;

(2) Confinement and war-like actions of enemy regardless a declaration has been made or not;

(3) Revolution, coup d’etat, riot, espionage, sabotage, work strike, job closure according to the Labour Act, rights diminishing, accident, earthquake, thunderstorm, fire, flooding, epidemic, unusual violent weather condition, bombing;

(4) Interference in power distribution network caused by accident on power distribution system or related equipment;

(5) Seizure of power plant, assets, shares, or any rights by any government institutions, government actions which critically impacts the Power Producer’s power plant or its operation according to the Agreement.

6.2 In case where a contracting party fails to follow requirements specified in this Agreement due to force majeure in 6.1, such contracting party shall not be deemed as violating the Agreement. The other contracting party shall not request for any compensations.

6.3 A contracting party claiming force majeure shall notify the other contracting party of such force majeure as soon as possible and provide details of force majeure and time period needed to solve the damages caused by such force majeure.

6.4 In case where a contracting party fails to follow requirements specified in this Agreement due to force majeure in 6.1, such contracting party shall not be deemed as violating the Agreement. The other contracting party shall not request for any compensations and allow for time extension period equal to the period that such force majeure incurred and ended unless the contracting party, which has the right to have the time extension, does not want to.

6.5 A contracting party claiming force majeure shall

(1) notify the other contracting party of such force majeure and provide details of force majeure and time period needed to solve the damages caused by such force majeure;

(2) be responsible for expenses and deliberate actions to end force majeure as soon as possible where such actions must be plausible actions that such contracting party is able to conduct.

7. Settlement of Dispute

7.1 The Power Producer who encounters any problems arising by performing incompliance with this Agreement shall notify the ERC. The written complaint shall submit to the Chairman of the ERC, ERC Office, No. 319, Jamjuree Square Building, 19th Floor, Phrayathai Road, Pathumwan, Bangkok 10330.

7.2 In case where there is an appropriate necessity for dispute settlement in problems arising from compliance to the Agreement, the ERC shall be the one who rules the dispute settlement. The decision of ERC is final.

7.3 In case where the Power Producer does not agree with the ERC decision, the court of Thailand shall rule the final settlement.

This Agreement is done in duplication where each copy is exactly identical. The contracting parties well read and understand the provisions of the Agreement, then sign and affix seal (if any) in front of witnesses. Each of the copies is equally authentic and kept by each of the contracting parties.

The Power Producer

Metropolitan Electricity Authority

Signature.....The Power Producer

Signature..... Metropolitan Electricity Authority

()

()

Position

Signature..... Witness

Signature..... Witness

()

()

Position

Annex 4.2

Draft of Power Purchase Agreement between Very Small Power Producer who produces electricity by using solar PV rooftop and Provincial Electricity Authority (PEA)

Provincial Electricity Authority

The Power Purchase Agreement No.....

Under the Notification of the Energy Regulatory Commission

on

Power Purchase from Solar PV Rooftop Dated

between and Provincial Electricity Authority

This Power Purchase Agreement (PPA) is made at the Provincial Electricity Authority (PEA)

on.....between

located at.....

represented by

hereafter called "Power Producer", a contracting party, and the MEA Office No. 30 Soi Chitlom, Ploenchit Road, Lumpini, Phatumwan, Bangkok 10330

represented by

hereafter called "PEA", another contracting party. Both parties agree to purchase and supply electricity subject to the following conditions:

1. Power Purchase

1.1 PEA agrees to purchase and Power Producer agrees to sell electricity generated from solar PV rooftop at the maximum sale capacity of (kW_p) (calculated from a combination of installed capacity of photovoltaic panels which share the same electrical circuit and point of power purchase and which is not exceeding maximum installed capacity specified for each type of building), with electric potential of Volt and details of power generating system as specified in the Application for Sale of Electricity and System Interconnection where the Scheduled Commercial Operation Date (SCOD) is on This Agreement shall be terminated on (+25 years from the SCOD). In this regard, the power purchase shall start from the Commercial Operation Date (COD).

Prior to the power purchase, license as prescribed by law shall be provided to PEA.

1.2 In case where the Power Producer anticipates that power cannot be supplied within the SCOD, the Power Producer shall notify PEA promptly in writing on all aspects of preparation including construction, power station location, source of capital fund, technology, and application of licenses required by relevant law. After consideration, PEA may see as appropriate to postpone the SCOD. The SCOD shall be postponed only once and to the deemed appropriate date within the period not more than 1 month from the day following the SCOD as specified in this Agreement. However this will not have any effect on the termination date as indicated in 1.1

2. Entry into Force and Termination of the Agreement

The Agreement shall come into force on the date that both parties sign the Agreement starting from the COD until it is terminated as in the following cases:

2.5 The Power Producer sends a notice of intent to terminate the Agreement in writing to PEA;

2.6 If a contracting party fails to fulfill one of the requirements under this Agreement, another contracting party shall notify in writing such contracting party to solve the problem. Upon the receipt of such notification, if the problem is unsolved, another contracting party has the right to terminate this Agreement;

2.7 The Power Producer who already signed the Agreement must comply to all specified conditions and must not modify the overall installed capacity of photovoltaic panels and point of power purchase, as well as equipments used in power generation, without approval from PEA;

2.8 In case where the Power Producer wants to transfer rights and operation duties as specified in the Agreement, approval from PEA is mandatory. And PEA must notify the Office of the Energy Regulatory Commission (ERC).

3. Safety Standards and Power Network Connection Standards

3.1 The Power Producer and PEA must follow power purchase conditions in accordance with the following:

3.1.3 The Regulation of the Energy Regulatory Commission on Power Purchase from Solar PV Rooftop B.E. ...

3.1.4 The Notification of the Energy Regulatory Commission on Power Purchase from Solar PV Rooftop

as provided in Annexes 1 and 2 respectively.

3.2 For the sake of power system stability, PEA has the rights to inspect or request the Power Producer to inspect, or modify their power supply equipments in connection with PEA's power system as deemed necessary. In this regard, PEA reserves its rights to, at a later date, add equipments both in PEA's power distributing system and in the Power Producer's power station in order to be consistent with PEA's technical standards and power distributing forms.

3.3 It shall be deemed that the Application for Sale of Electricity from Solar PV Rooftop and documents listed in 3.1 are part of this Agreement. In case where there is a conflict between statements in Annexes and in this Agreement, the statements in this Agreement shall prevail.

3.4 A contracting party shall notify another contracting party in advance if there is any modification in its own power system which will affect protection equipments of both parties. Interconnection equipments must not be modified without sending a prior notification to MEA.

3.5 The Power Producer who is connected to PEA's power system must follow safety standards and connection standards in 3.1 and PEA's specifications of power network connection system which are currently effective.

Once there is power purchase, the Power Producer must inspect and maintain power supply equipment, control and protection system, as well as communication equipment in good condition. The Power Producer must send annually the results of its inspection to PEA for consideration. In this regard, MEA reserves its rights to send its officer to co-inspect the Power Producer's annual maintenance process in order to ensure safety and stability towards the power system, PEA's operating officers, and the Power Producer. In case where deemed as necessary, PEA has the rights to inspect or request the Power Producer to inspect, or modify their power supply equipments in connection with PEA's power system.

3.6 The Power Producer and PEA must install protection equipment, according to specifications of power network connection system which are currently effective, to prevent any damages on power network. In case there is any damage resulted from failure of electrical equipment or other causes within responsibility from a contracting party, that contracting party will be held responsible for such damage.

4. Control and Operation of Power Plant

4.1 For the Power Producer with voltage of 22 kV and over must strictly follow Switching Order of MEA's Distribution Dispatching Center for the benefits of operation and maintenance except in case where it may lead to danger to life and property of any of the contracting parties.

4.2 The Power Producer shall allow PEA to enter its premises in order to install, operate, maintain, modify, and/or move electrical equipments once the owner of such premises has been notified.

4.3 It is prohibited for the Power Producer to supply electricity produced from power generating sources other than that generated from solar energy by using photovoltaic panel technology. Under this Agreement, if it is found otherwise, it shall be deemed that the Power Producer violates the Agreement resulting in the immediate termination of the Agreement. The Power Producer shall be prosecuted and not be able to claim any compensation from PEA. Penalty must be paid to PEA at the rate of 10,000 baht per kW_p of the photovoltaic panel as specified in 1.1 and all charges received from the COD on sale of electricity must be paid back to PEA.

5. Calculation of Power Purchase Quantity and Payment

5.1 Calculation of power purchase quantity and payment shall be in accordance with specifications described in Sections 15, 16, and 17 of the Regulation of the Energy Regulatory Commission on Power Purchase from Solar PV Rooftop

In any month where the Power Producer supplies more electricity to PEA than what was specified in the Agreement, PEA shall not pay the excess portion to the Power Producer.

5.2 In case where PEA fails to make payment within 30 days from the date of receiving the invoice, PEA shall allow the Power Producer to calculate interest on the remaining amount due at the rate equal to minimum loan rate of Krungthai Bank Public Company Limited. The interest shall be calculated from the default date until the remaining amount due is settled. However the interest rate used in calculation must not be more than 15% per annum.

6. Force Majeure

6.1 “Force Majeure” means any event, the happening or pernicious result of which could not be prevented even though a person against whom it happened or threatened to happen were to taken such appropriate care as might be expected from him in his situation and in such condition. The force majeure includes on or combination of the following:

(1) Government actions such as change of energy policy or law which causes a contracting party unable to follow any power purchase regulation;

(2) Confinement and war-like actions of enemy regardless a declaration has been made or not;

(3) Revolution, coup d’etat, riot, espionage, sabotage, work strike, job closure according to the Labour Act, rights diminishing, accident, earthquake, thunderstorm, fire, flooding, epidemic, unusual violent weather condition, bombing;

(4) Interference in power distribution network caused by accident on power distribution system or related equipment;

(5) Seizure of power plant, assets, shares, or any rights by any government institutions, government actions which critically impacts the Power Producer’s power plant or its operation according to the Agreement.

6.2 In case where a contracting party fails to follow requirements specified in this Agreement due to force majeure in 6.1, such contracting party shall not be deemed as violating the Agreement. The other contracting party shall not request for any compensations.

6.3 A contracting party claiming force majeure shall notify the other contracting party of such force majeure as soon as possible and provide details of force majeure and time period needed to solve the damages caused by such force majeure.

6.4 In case where a contracting party fails to follow requirements specified in this Agreement due to force majeure in 6.1, such contracting party shall not be deemed as violating the Agreement. The other contracting

party shall not request for any compensations and allow for time extension period equal to the period that such force majeure incurred and ended unless the contracting party, which has the right to have the time extension, does not want to.

6.6 A contracting party claiming force majeure shall

(1) notify the other contracting party of such force majeure and provide details of force majeure and time period needed to solve the damages caused by such force majeure;

(2) be responsible for expenses and deliberate actions to end force majeure as soon as possible where such actions must be plausible actions that such contracting party is able to conduct.

7. Settlement of Dispute

7.1 The Power Producer who encounters any problems arising by performing incompliance with this Agreement shall notify the ERC. The written complaint shall submit to the Chairman of the ERC, ERC Office, No. 319, Jamjuree Square Building, 19th Floor, Phrayathai Road, Pathumwan, Bangkok 10330.

7.2 In case where there is an appropriate necessity for dispute settlement in problems arising from compliance to the Agreement, the ERC shall be the one who rules the dispute settlement. The decision of ERC is final.

7.3 In case where the Power Producer does not agree with the ERC decision, the court of Thailand shall rules the final settlement.

This Agreement is done in duplication where each copy is exactly identical. The contracting parties well read and understand the provisions of the Agreement, then sign and affix seal (if any) in front of witnesses. Each of the copies is equally authentic and kept by each of the contracting parties.

The Power Producer

Provincial Electricity Authority

Signature.....The Power Producer

()

Signature..... Provincial Electricity Authority

()

Position

Signature..... Witness

()

Signature..... Witness

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Position

Specifications of Materials, Equipment, and Solar PV Rooftop Installation

1. Specifications of Solar Power Generating System

A solar power generating system comprises of photovoltaic panels which will generate direct current from solar energy. The generated direct current will be sent to grid connected inverter to convert into alternative current before the current will be supplied through watt hour meter and connected to power distributing system of the Power Distributor⁻³ as shown in the Diagram:

⁻¹ means solar PV rooftop installer

⁻² means person with installed solar PV rooftop

⁻³ means Provincial Electricity Authority or Metropolitan Electricity Authority

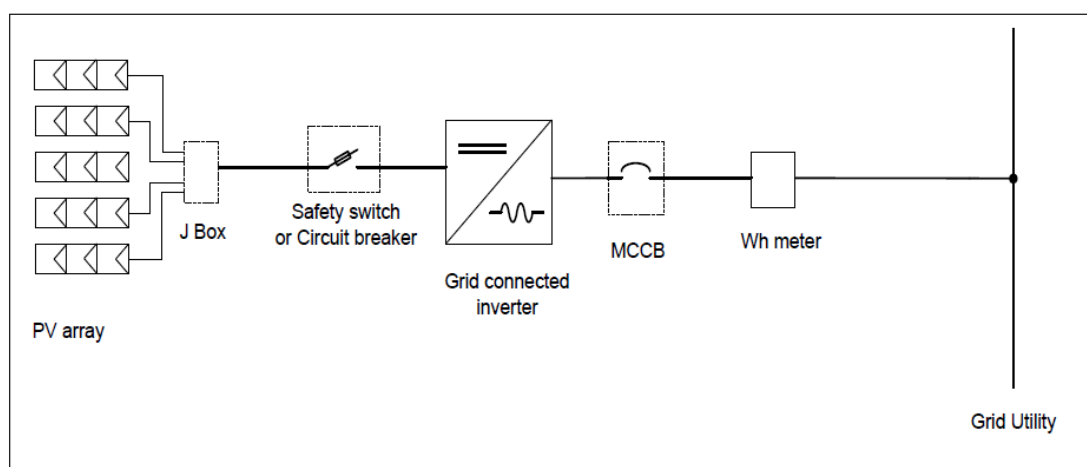


Diagram on Grid Connected Photovoltaic System at Low Penetration Level

2. Solar System The solar system to be installed on building's roof comprises of materials, and equipment with specifications provided in 3. including other necessary installing materials that the installer use in installation of the system at the targeted location to ensure accuracy, tidiness, and safety.

3. Specifications of Materials and Equipment

3.1 Photovoltaic Panel must have the following specifications:

3.1.1 In case the type of photovoltaic panel is “Crystalline Silicon”, its manufacture and model must be approved by TISI 1843 or IEC 61215 Crystalline silicon terrestrial photovoltaic (PV) modules-Design qualification and type approval;

3.1.2 In case the type of photovoltaic panel is “Thin Film”, its manufacture and model must be approved by TISI 2210 or IEC 61646 Thin-film terrestrial photovoltaic (PV) modules-Design qualification and type approval;

3.1.3 PV panel should be a product which has been approved by TISI 2580 or IEC 61730 Photovoltaic (PV) module safety qualification or is a product with specifications according to TISI 2580 or IEC 61730 which has test report approved and issued by an accredited laboratory according to TISI 17025 or ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories;

3.1.4 There should be a copy of certificate of industrial standard as specified in 3.1.1 or 3.1.2 issued by Certification Body (CB).

3.2 Photovoltaic Panel Structure must have the following specifications:

3.2.1 The materials used in constructing structure should be hot dip galvanized steel according to ASTM standard or stainless metal;

3.2.2 Components of structure should be easily detached and composed;

3.2.3 Materials and equipment holding the photovoltaic panel to the structure and equipment holding the structure to the building should have appropriate size and made from stainless steel or stainless metal;

3.2.4 Structure should securely support the photovoltaic panel and also be securely fixed to the roof with ability to hold its weight and stand the wind speed not less than the maximum speed of tropical storm announced by the Thai Meteorological Department or the wind speed as specified in municipal law or relevant local administrator’s regulation (if any).

3.3 Grid Connected Inverter must have the following specifications:

3.3.1 Its manufacturer and model must be approved by IEC 61727 Photovoltaic (PV) systems – Characteristics of the utility interface and IEC 62116 Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters or be a product with test report approving specifications according to TISI 61727 or IEC 62116;

3.3.2 There must be a copy of certificate of industrial standard as specified in 3.3.1 issued by Certification Body (CB) or a test report showing that specified qualifications are met where the test report must be issued by an accredited laboratory according to TISI 17025 or ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories;

3.3.3 Its electrical specification must be in accordance with the Power Distributor's Regulation on Specifications on Power Network Connection B.E. 2551 or other relevant regulations where test report, issued by testing unit approved by the Power Distributor, must be provided.

3.4 Materials and Accessory Equipment must have the following specifications:

3.4.1 Direct Current Control Device

- 1) In case of safety switch,
 - (1) the device must be of Fusible Type 1 Phase 2 Wires or other types with better qualifications;
 - (2) the structure must be made of metal with cover protecting the switch when it stays at ON position;
 - (3) the fuse must be DC fuse with rated current not less than 1.25 times of I_{sc} (short circuit current) at the Standard Test Condition (STC) of the photovoltaic panel;
- 2) In case of circuit breaker;
 - (1) the device must be molded case circuit breaker (MCCB);
 - (2) the device must be a product according to IEC 898 or IEC 947-2 or other equivalent or better qualification;
 - (3) the device must have Ampere trip, AT not less than 1.25 times of I_{sc} at the STC of the photovoltaic panel.

3.4.2 Alternating Current Control Device

- 1) The device must be MCCB;
- 2) The device must be a product according to IEC 898 or IEC 947-2 or other equivalent or better qualification;
- 3) The device must have Ampere trip, AT not less than 1.25 times of rated power at unity power factor of electrical inverter specified in **3.3**.

3.4.3 Wire

- 1) The wire must be photovoltaic wire which is suitable for temperature not less than 80°C or be of the type with 0.6/1 KV CV according to IEC 60502 or other types of wire with better specification;
- 2) The wire must be suitable for direct current with rated current not less than 1.25 times of I_{sc} at the STC and is in accordance with specifications in **4.7.1**;
- 3) The wire must be suitable for alternating current with rated current not less than 1.25 times of rated power at unity power factor of electrical inverter specified in **3.3** and is in accordance with specifications in **4.7.1**.

3.4.4 Electrical Conduit

- 1) In case of polyethylene pipe, the pipe must be high density polyethylene pipe (HDPE) at quality level PN 8 or higher and must be a product according to TISI 982;
- 2) In case of metal pipe, the pipe must be EMT or better quality pipe.

3.4.5 DC Junction Box

- 1) It must be metal or hard plastic box suitable for outdoor use;
- 2) The box must have ingress protection (IP) at the level IP 45 or higher;
- 3) The power connector inside the DC junction box must be installed in a professional manner.

4. Solar PV Rooftop Guidance

4.1 The installer must inspect the installing location and design solar PV rooftop installing plan by including details of shop drawing, list of materials, equipment, manufacturer, model, together with catalog of materials and equipment with specified qualifications, and other relevant documents and list of necessary calculation.

4.2 Solar PV rooftop installing plan, and shop drawing including relevant calculation, must be done and certified by an engineer with a license of professional practice from Council of Engineers.

4.3 To design the solar PV rooftop installing plan, the surface receiving the solar energy should be facing south or near south with an angle of 10 – 20 degree from the north-south horizontal surface or to the slope of targeted building's roof. The installing location must be in an open area without any shading on the panels which may result in hot spot and the solar PV rooftop installation must be secured, and easily maintained.

4.4 Photovoltaic panel circuit set should be connected in a professional manner for safety with reference to TISI 2572 Electric installation – solar power supply systems or IEC 60364-7-712 Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems or Power Producer's Guideline on photovoltaic panel installation (if any).

4.5 Electric wiring between photovoltaic panels should be securely done using wire attached with Terminal box of the PV panels or using photovoltaic wire or CV 0.6/1 KV -wire or better quality with the size not less than 2.5 sq.mm. or the size as specified in or Power Producer's Guideline on photovoltaic panel installation (if any), and PV connector or other types of connector that are equally strong or stronger.

4.6 PV panels and equipment which have metal structure and/or equipment which requires ground system, all ground wires must be connected in a professional manner with reference to Electricity Installation Standards for Thailand B.E. 2545 (Latest Amendment B.E. 2551) set by Engineering Institute of Thailand.

4.7 The wire size must be suitable for current rating not less than 1.25 of the maximum current in circuit and have voltage drop not more than the following:

4.7.1 DC Side: all wires from PV string and inverter must have voltage loss not more than 3% of I_{mp} of PV panels compared with V_{mp} of PV panels at STC;

4.7.2 AC Side: all wires from Inverter's Output to Power Distributor's Supply System Connection Point must have voltage loss not more than 3% of I_{mp} compared with Output Voltage at unity power factor of inverter specified in **3.3**.

4.8 System wires must have specifications as prescribed in **3.4.3** (except **4.11** electric wire utilisation and installation must be in accordance with relevant rules/regulations issued by the Power Distributor). Wires must be routed in a tidy and professional manner with reference to Electricity Installation Standards for Thailand B.E. 2545 (Latest Amendment B.E. 2551) set by Engineering Institute of Thailand or rules/regulations accepted by the Power Distributor.

4.9 In case of wire installation in electric conduit, HDPE or better quality pipe should be used for installation outside the building, and EMT or better quality pipe should be used for installation inside the building.

4.10 All supporting equipments must be installed in a neat and tidy manner which can be easily used or inspected. Wire connection must be held, in a professional manner, by proper electric connector which is strong and safe.

4.11 In case where solar PV rooftop has output power at the level that is connected to HV System as in accordance with Power Distributor's Regulation on Power Network Connection B.E. 2551 and/or other relevant regulations, the installer must provide all supporting equipments suitable for HV system connection which are accepted by Power Distributor, and install as in accordance with relevant rules/regulations.

4.12 Once solar PV rooftop is installed, the installer must arrange for an engineer with a license for professional practice from the Council of Engineers to come and inspect whether the installation was done safely in a professional manner and that all materials and equipment have specifications as required. The installer must also prepare for a document which must be signed by such engineer to approve inspection results.

4.13 The installer must coordinate with relevant agencies to ask for permission to connect solar PV rooftop system with power distributing system of Power Distributor, and must arrange for an engineer with a license for professional practice in electrical engineering from the Council of Engineers to come and inspect whether the system is running as indicated in relevant rules/regulations to show to the installed party that the system can be used to generate power.

4.14 The installer must provide a basic guideline to use and maintain the system, and advice the installed party on: how to operate and primary inspect the system; and contact information for maintenance in case of default or damage.

4.15 The installer must provide warrantee on the operation of solar PV rooftop system not less than 2 (two) years from the date that the system is installed and tested. During the warrantee period, the installer must solely be responsible for all expenses incurred from maintenance or changes of materials and equipment which have been damaged as a result of normal usage of the system.

Annex 6.1**The Regulation on Grid Connection of Metropolitan Electricity Authority (MEA)**

Solar PV Rooftop power generating system must follow the regulation of MEA's grid connection which divided into 4 parts as follows:

Part 1: Requirements for an Inverter Used in Grid-connected Power Generating System

The inverter used in Solar PV Rooftop must have qualifications as required in the "Requirements for an Inverter Used in Grid-connected Power Generating System" and a report must be attached to show a test result that the inverter meets all requirements. This report must be published by an institute or unit that is impartial and certified ISO/IEC 17025 (for inverter) from a laboratory or inspected and approved by the Metropolitan Electricity Authority.

Part 2: Restriction on Solar PV Rooftop Power Generating System's Capacity

The installed capacity of Solar PV Rooftop that can connect to electrical system in each area must abide the "Restriction on Solar PV Rooftop Generating System's Capacity."

Part 3: Meter Installation Format

The standard format of connection and meter installation including its equipment must be as the Metropolitan Electricity Authority required in which MEA has the authority to change the format of connection and meter installation for suitability, safety and grid system liability, and Solar PV Rooftop generators must accept and practice.

Part 4: Qualifications of Power Quality Meter

In order to effectively examine and control the level of power quality, power producers who have over 250 kilowatt installed capacity must provide and install the qualified power quality meter as required in the MEA's requirements at the power system connection's spot.

Other qualifications and conditions in connecting to Solar PV Rooftop system must abide the Metropolitan Electricity Authority Rules concerning Grid System B.E. 2551.

Part 1

Regulation for an Inverter

Used in Grid-connected Power Generating System

of the Metropolitan Electricity Authority

1. Boundary and objectives

This regulation is conducted to identify technical conditions in connecting to electrical system and the test guideline of grid-connected inverters that are used in power generating system of connectors: Small Power Producer (SPP), Very Small Power Producer (VSPP) or power users who have electric generators connected in parallel to MEA's power system. The objective is to control the impact of these inverters that may have upon electrical system both in terms of quality and safety to human and property.

This regulation applies for inverters for every type of connectors. If the inverter is designed to use with a low energy system (230/400 V) connection, that inverter must pass the test and has technical qualifications as required in this regulation before it will be allowed to connect with the grid system of the Metropolitan Electricity Authority.

The publication of this regulation uses a reference from international standard that relates to grid-connected inverter both from the requirements on grid connection's condition and the inverter test guideline. The principles of using reference from international standard are as follows:

- In the subject that the standard in the aforementioned reference are complete, all will be used as a reference.
- In case it is the same subject but the content is varied with each standard, the content from the standard that is more applicable with the MEA's system will be considered.
- In the subject that the content in the referred standard does not apply with the electrical working system of the MEA, the content will be adjusted to align with the electrical working system.

These international standards are IEC 61727-2004, IEC 62116-2008, IEEE 15447-2003, IEEE 1547.1-2005 and AS 4777.3-2005. Therefore, the referred standards mentioned above are parts of this regulation. Any subject in this regulation that does not have details will refer to details in these standards instead.

2. Definition

2.1 Inverter

Equipment that changes direct current (DC) power from solar panels or other DC generating sources to alternating current (AC) which is suitable and applicable power for MEA to utilize

2.2 Grid-connected Inverter

A type of inverter that will have to stop distributing power to power distribution system when the voltage and/or frequency in the power system are not normal as required or when Islanding takes place

2.3 Harmonic

A component in a form of sine wave of the signal or the amount of period that is an integer multiple of the fundamental frequency

For electrical system in Thailand, the fundamental frequency is 50 Hz. Therefore, a component with 100 Hz frequency is called the second harmonic and a component with 150 Hz is called the third harmonic.

2.4 Total Harmonic Current Distortion, THDi

The ratio of Root-Sum-Square of RMS current of the harmonic component and RMS current of the fundamental component in the percentage is

$$\text{THDi (\%)} = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + \dots}}{I_1} \times 100$$

2.5 Voltage Fluctuation of Flicker

Continuous changes in RMS value (or Peak) of the voltage between the two similar voltage levels in which each level has a steady value for a specific duration but the length of the duration is not designated

2.6 Islanding

A condition in which a part of grid power system, which consists of load and electric generator, continues to work consistently and separates itself from the rest of grid power system. Load and electric generator may be a combination of MEA's asset and electric users.

3. The Technical Requirements for Inverter

3.1 Power Quality Control

3.1.1 Harmonic

When the inverter distributes electricity to the balanced linear load, the inverter must not distribute harmonic current to grid power system over Arms below: (displays in the percentage compared to the inverter's current rating)

Odd rank	Arms (%)		Even rank	Arms (%)
3-9	4.0		2 – 10	1.0
11-15	2.0		12 – 16	0.5
17-21	1.5		18 – 22	0.375
23-33	0.6		24 – 34	0.15
≥ 35	0.3		≥ 36	0.075
THDi 5.0%				

3.1.2 Voltage Fluctuation or Flicker

The inverter must not cause voltage fluctuation or flicker over the limitation specified by IEC 61000-3-3 (2008) standard. This is for the inverter with current rating not over 16 A or IEC 61000-3-5 (2009) standard, the inverter with current rating over 75 A or IEC 61000-3-11 (2000) standard and the inverter with current rating not over 75 A.

3.1.3 DC Injection

The inverter must not inject DC to grid more than 0.5% of the inverter's current rating.

3.2 Response to Electrical System

3.2.1 Voltage Range

The inverter must open circuit from the grid system if the voltage of Line to Line or Line to Neutral in the grid system differs from 346 – 416 V and 200 – 240 V chronologically in the duration listed below:

Voltage Range (Volt)		Maximum Time of Open Circuit (Second)
Line to Line	Line to Neutral	
V < 199	V < 115	0.3
119 ≤ V < 346	115 ≤ V < 200	2.0
346 ≤ V ≤ 416	200 ≤ V ≤ 240	Continue to run (no open circuit)
416 < V < 539	240 < V < 311	2.0
V ≥ 539	V ≥ 311	0.05

3.2.2 Frequency Range

The inverter must open circuit from the grid system within 0.1 seconds if the frequency of the grid differs from 49 – 51 Hz.

3.2.3 Islanding Prevention

When islanding takes place, the inverter must discover and open circuit from the grid system within 2 seconds.

However, the Metropolitan Electricity Authority has installed the automatic power supply switch system when the power supply system is down to reduce power outage time and impact on electric users. While this system is running, electric users will experience power outage around 0.3 seconds which means the inverter will undergo islanding for 0.3 seconds likewise.

After 0.3 seconds elapse, when the MEA system distributes voltage again, if the inverter does not open circuit during that time, out of synchronization may occur. The voltage distributed from the inverter will have different phase angle from the voltage distributed by MEA system which may cause surge and damages to the inverter and other equipment in the electrical system.

Hence, when islanding occurs and the connector's inverter does not open circuit from the grid system within 0.3 seconds and causes damages to the electrical system of the connector or the MEA system due to out of synchronization, the connector has to take responsibility to the aforementioned damages.

3.2.4 Response to Utility Recovery

After the inverter opens circuit due to power outage or out of ranges voltage/frequency and when the grid system recovers, the inverter must delay the connection to the grid system for at least 2 minutes.

4. Inverter Test Guideline

4.1 Test Institute or Unit

The inverter must undergo a test from an impartial institute or unit and certified ISO/IEC 17025 (for inverter) standard from a test laboratory or is inspected and approved by the Metropolitan Electricity Authority.

4.2 Test Category

4.2.1 Design Test

It is a test with just one inverter that represents the model to confirm that the to-be-installed inverter has an appropriate and applicable design as required in the regulation both in terms of power quality control and electrical system response. The model that has already been through a design test does not have to go through the test again.

The design test must include all topics which are harmonic, voltage fluctuation, DC injection, voltage range, frequency range, islanding prevention, response to utility recovery, and must go through a test by an institute with qualifications listed on 4.1.

4.2.2 Routine Test

It is a test done with every to-be-installed inverter to ensure the highest security and prevent damages that may occur to electrical system. The topics of the routine test include voltage range, frequency range and islanding prevention.

The routine test can be conducted by an institute with qualifications in 4.1 or a test laboratory of an inverter manufacturer that has been inspected and approved by the Metropolitan Electricity Authority.

4.3 Test Method and Evaluation

4.3.1 Harmonic Test

It is a design test referring to the test method and evaluation in IEEE 1547.1 – 2005 standard, item 5.11.1, which designates to test harmonic current value when the inverter is working at 35%, 66% and 100% of current rating.

4.3.2 Voltage Fluctuation Test

It is a design test referring to the test method and evaluation in IEC 61000-3-3 (2008) for an inverter with current rating not over 16 A or IEC 61000-3-5 (2009) standard, an inverter with current rating more than 75 A or IEC 61000-3-11 (2000) standard and an inverter with current rating not over 75 A.

4.3.3 DC Injection Test

It is a design test referring to the test method and evaluation in IEEE 1547.1-2005 standard, item 5.6, which designates to test DC value when the inverter is working at 33%, 66% and 100% of current rating.

4.3.4 Voltage Range Test

(1) Design Test

1.1) Test method

The test is divided into two parts, Overvoltage and Undervoltage, as shows below:

Topic	Test Amount	Test Method
Over-voltage	5 x m ₁ x n	(1) Install the inverter set as the installation guideline and requirements from the manufacturer. (2) Set all electricity distributing sources to function normally as the inverter set required. (3) Set Overvoltage Trip Setting of the inverter set at the voltage test value (see remarks m ₁) and set the other settings in the inverter set at regular working condition. (4) Increase the voltage rapidly to test. Set the value at Overvoltage Trip Setting + 1 V and stabilizes until the inverter stops distributing electricity to the system. (5) Record the period of time that the inverter stops distributing electricity to the system (6) For 3 phase inverter, the test will be conducted phase by phase until complete then test all 3 phase altogether. While one phase is being tested, the voltage in other phases will be set at regular working level.
Under-voltage	5 x m ₂ x n	(1) Install the inverter set as the installation guideline and requirements from the manufacturer. (2) Set all electricity distributing sources to function normally as the inverter set required. (3) Set Undervoltage Trip Setting of the inverter set at the voltage test value (see remarks m ₂) and set the other settings in the inverter set at regular working condition. (4) Decrease the voltage rapidly to test. Set the value at Undervoltage Trip Setting - 1 V and stabilizes until the inverter stops distributing electricity to the system. (5) Record the period of time that the inverter stops distributing electricity to the system (6) For 3 phase inverter, the test will be conducted phase by phase until complete then test 3 phase altogether. While one phase is being tested, the voltage in other phases will be set at regular working level.
Remarks: m ₁ is the amount of the voltage that is too high so it must be tested twice at 241 V and at 311 V* m ₂ is the amount of the voltage that is too low so it must be tested twice at 199 V and 114 V* n is the amount of the additional test times for 3 phase inverter in which the test will be conducted one by one and 3 phase altogether. * In case that the Overvoltage Trip Setting and/or Undervoltage Trip Setting of the inverter cannot be adjusted to 311 V and/or 114 V, the Overvoltage Trip Setting and/or Undervoltage Trip Setting can be adjusted to the highest voltage and/or the lowest voltage that the inverter can adjusted chronologically.		

1.2)Evaluation

For each test, the inverter must stop distributing electricity to the system in the period of time specified in 3.2.1.

(2) Routine Test

Use the design test's test method and evaluation as a reference but reduce the number of times; for Overvoltage, test m₁ x n times, and for Undervoltage, test m₂ x n times.

4.3.5 Frequency Range Test

(1) Design Test

1.1)Test method

The test is divided into two parts, Overfrequency and Underfrequency, as shows below:

Topic	Test Amount	Test Method
Over-frequency	5	(1) Install the inverter set as the installation guideline and requirements from the manufacturer. (2) Set all electricity distributing sources to function normally as the inverter set required. (3) Set Overfrequency Trip Setting of the inverter set at 51.1 Hz and set the other settings in the inverter set at regular working condition. (4) Increase the frequency rapidly to test. Set the value at Overfrequency Trip Setting + 0.1 Hz and stabilizes until the inverter stops distributing electricity to the system. (5) Record the period of time that the inverter stops distributing electricity to the system
Under-frequency	5	(1) Install the inverter set as the installation guideline and requirements from the manufacturer. (2) Set all electricity distributing sources to function normally as the inverter set required. (3) Set Underfrequency Trip Setting of the inverter set at 48.9 Hz value test and set the other settings in the inverter set at regular working condition. (4) Decrease the voltage rapidly to test. Set the value at Underfrequency Trip Setting – 0.1 Hz and stabilizes until the inverter stops distributing electricity to the system. (5) Record the period of time that the inverter stops distributing electricity to the system

1.2) Evaluation criteria

For each test, the inverter must stop distributing electricity to the system within 0.1 seconds.

(2) Routine Test

Use the design test's test method and evaluation as a reference but reduce the number of times; for Overfrequency, test 1 time, and for Underfrequency, test 1 time.

4.3.6 Islanding Prevention Test

(1) Design test

1.1) Test method

Refer to a test method in IEC 62116-2008 standard.

1.2) Evaluation criteria

For each test, the inverter must stop distributing electricity to the system within 2 seconds.

(2) Routine Test

2.1) Test method

Test by using a test method in item 6.1 of the IEC 62116 – 2008 standard but test only with the following test conditions:

Condition	% Change in Real Load, Reactive Load from Nominal	Test Times
A	0 , 0	1
B	0 , 0	1

C	0,0	1
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Remarks

- Condition A means the inverter working at Maximum Output Power and the voltage putting in the inverter is more than 90% of voltage rating.
- Condition B means the inverter working between 50% - 66% of Maximum Output Power and the voltage putting in the inverter equals 50% of $\pm 10\%$ voltage rating.
- Condition C means the inverter working between 25% - 33% of Maximum Output Power and the voltage putting in the inverter is less than 10% of voltage rating.
- % change in real load, reactive load from nominal = 0,0 means that the energy from both real power and reactive power distributed from the inverter were absorbed by AC loads in a circuit. Thus, the value of real power and reactive power that flow to AC Power Source equals zero.

2.2) Evaluation criteria

For each test, the inverter must stop distributing electricity to the system within 2 seconds.

4.3.7 Response to Utility Recovery Test

It is a design test referring to the test method in IEEE 1547.1 – 2005 standard, item 5.10. As for the evaluation, it refers to item 3.2.4 in this requirements.

Part 2

**Restriction on Solar PV Rooftop
Power Generating System's Capacity
of the Metropolitan Electricity Authority**

**Restriction on Solar PV Rooftop Power Generating System's Capacity
that can connect to the electrical system of the Metropolitan Electricity Authority**

To control the impact from Solar PV Rooftop power generating system that may occur to electrical voltage level, power quality and liability of electrical system, the Metropolitan Electricity Authority (MEA), therefore, designates the restriction of Solar PV Rooftop's total capacity that can connect to the electrical system of MEA as follows:

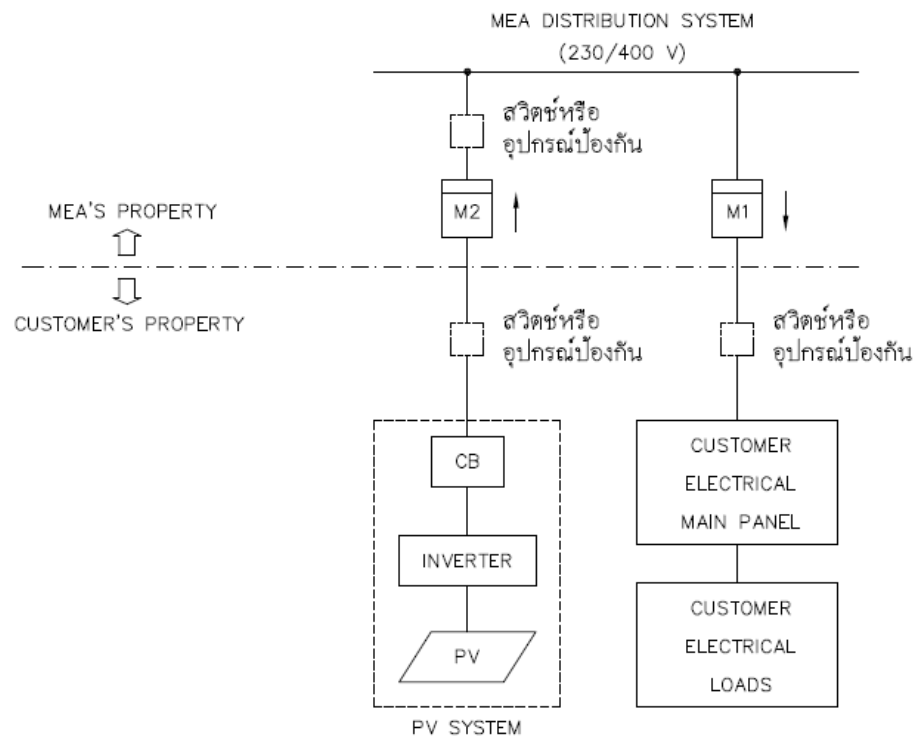
- a) Low volt electrical system (230/400 volts) connection
 - If it is a single phase power generating system, the capacity must not exceed 10 kilowatt per applicant.
 - The total capacity of Solar PV Rooftop (the unit is kilowatt) that connects to a distribution transformer of MEA must not exceed 15% of the distribution transformer's rating (the unit is kilowatt – ampere). If the distribution transformer is already connected by Solar PV Rooftop to the limitation of 15%, it will not be able to sustain any more connection from Solar PV Rooftop.
 - In case that the VSPP applicant still intends to sell electricity although the distribution transformer in that area already reaches the limitation of Solar PV Rooftop, the applicant can connect to sell electricity in 12 or 24 kilovolt system. The applicant must find and install the distribution transformer along with the preventive equipment by MEA standard. The other details will be as listed in condition b)

- b) Medium volt electrical system (12 or 24 kilovolt) connection
 - The power generating system that has capacity (the unit is kilowatt) exceeding 15% of the distribution transformer's rating (the unit is kilowatt-ampere) in that area must connect to sell electricity in 12 or 24 kilovolt system. The applicant must find and install the distribution transformer along with the preventive equipment by MEA standard.
 - The total capacity of a power generator from every type of power producers (both Solar PV Rooftop and other power generators) that is installed in the same feeders must not exceed 8 megawatt/feeder for 24 kilovolt system and 4 megawatt/feeder for 12 kilovolt system.
 - If the total capacity of the power generator from every type of power producers that is installed in one feeder reaches the limitation mentioned above, MEA will not purchase any more electricity in that feeder.


Nonetheless, condition a) and b) are general provisions. MEA reserves the right to adjust the limitation of the power generating capacity as necessary to maintain electric voltage, power quality and liability of the electrical system as standard and to not impact overall electric users.


Part 3
Meter Installation Format
of the Metropolitan Electricity Authority

1. Power users purchase and sell low volt electricity (230/400 volts)

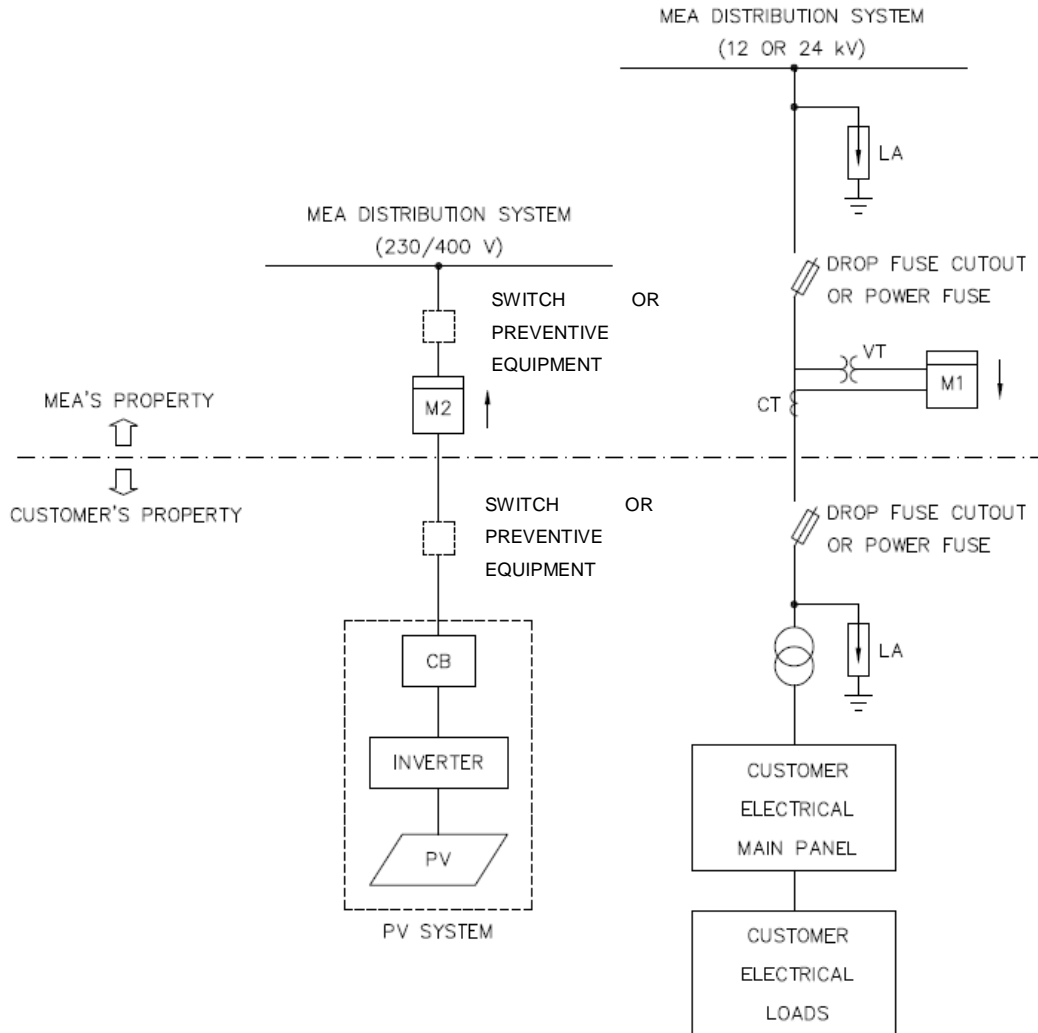


 M1 = REVENUE METER

 M2 = PV OUTPUT METER

 = อาจจะมีหรือไม่มีก็ได้ ขึ้นอยู่กับการพิจารณาของ กฟน

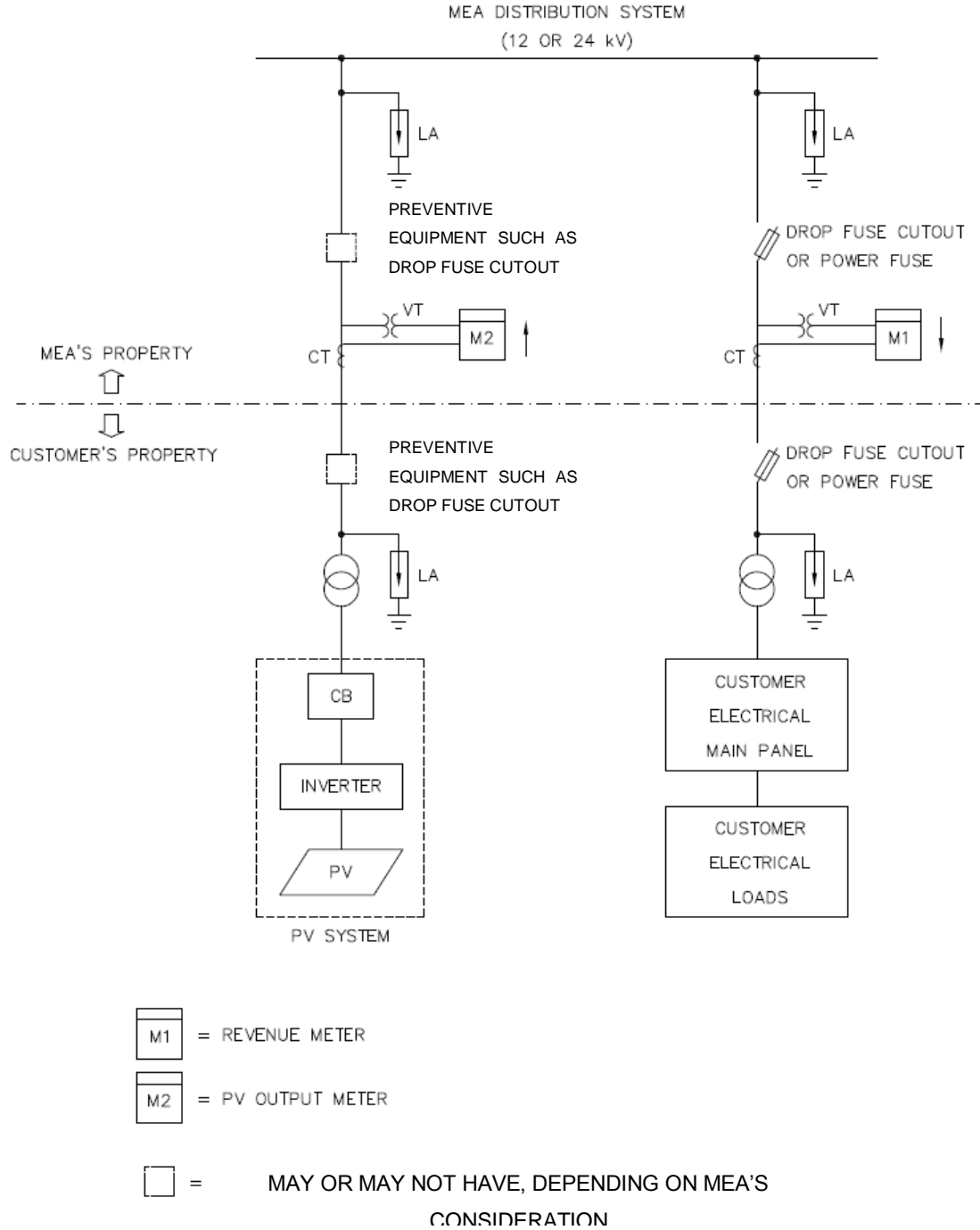
2. Power users purchase high volt electricity (12 or 24 KV) and sell low volt electricity (234/400 volts)



M1 = REVENUE METER
 M2 = PV OUTPUT METER

[] = MAY OR MAY NOT HAVE, DEPENDING ON MEA'S CONSIDERATION

3. Power users purchase and sell high volt electricity (12 or 24 KV)



Part 4

Qualifications of Power Quality Meter

of the Metropolitan Electricity Authority

Power Quality Meter Qualification of the Metropolitan Electricity Authority

- Power quality meter shall measure and record the 3 phase true RMS electrical value in 2 categories which are Profile Recording and Event Recording.
- Profile recording is the continuous recording of average, minimum and maximum RMS value over 10 minutes period including Voltage, Ampere, Real Power, Reactive Power, Apparent Power, Power Factor, Harmonics (Voltage, Current and Power up to 50th), Voltage Unbalance (Unbalance Factor, Positive Sequence Voltage, Negative Sequence Voltage and Zero Sequence Voltage) and Flicker (Short Term Flicker Index, Pst, and Long Term Flicker Index, Plt). Note except Plt which calculate over 2 hours period.
- Event recording is the condition triggered recording of a voltage and current waveform of an abnormal event including Voltage Sag (Dip), Voltage Swell and Short Interruption with the minimum sampling resolution of 128 samples per cycle and allow user to adjust the trigger condition.
- Power quality meter shall comply with international standard IEC 61000-4-30 (power quality measurement method) class A performance, IEC 61000-4-7 (harmonics) and IEC 61000-4-15 (flicker).
- The internal memory of power quality meter shall be enough to store all measurement data at least 7 days without data loss.
- Power quality meter shall have an internal battery backup for ride through capability at least 1 hour in case of power supply failure and shall have an automatic restart function in case of back up battery deplete.

The Requirements on Grid Connection of Provincial Electricity Authority

1. Technical Requirements

1.1 Voltage and Frequency

The voltage and frequency of power generating system of very small power producer (VSPP) must respond to grid system belonging to Provincial Authority Electricity (PEA) and comply with the Provincial Electricity Authority rules concerning the Regulations on Grid Connection B.E.2551.

1.2 Harmonics

The power generating system of VSPP must not inject harmonic current to the grid system exceeding the limit based on the PEA's rules concerning the Regulations of Grid Connection B.E.2551. In terms of verification at other levels of voltage beyond the aforementioned requirements, the appropriate standard of IEC must be applied.

1.3 Voltage Fluctuation

The power generating system of VSPP must not create voltage fluctuation exceeding the limit based on the PEA's rules concerning the Regulations on Grid Connection B.E.2551.

1.4 DC Injection

The power generating system of VSPP must not supply direct current to the grid system exceeding the limit based on the PEA's regulations concerning the Regulations on Grid Connection B.E.2551.

1.5 Reactive Power Control

The power generating system of VSPP must be able to control power factor (PF) or reactive power to maintain voltage level at PCC aligned with PEA's standards. The power generating system of service applicants must have capacity as stated in Table 1.

Table 1. Power Factor Control of Power System Classified by Voltage Level at PEA's PCC

Voltage Level at PCC	* Capacity in Adjusting Power Factor	Reactive Power Control Methods
1) Low voltage 2) Moderate voltage or high voltage (electrical installation not exceeding 500 kilowatt).	0.95 lagging to 0.95 leading as a minimum	At least one method can control which is a fixed displacement factor $\cos \theta$
3) Moderate voltage or high voltage (electrical installation exceeding 500 kilowatt).	0.90 lagging to 0.90 leading as a minimum	At least two methods can control which are: 1) A fixed displacement factor $\cos \theta$

		2) A variable reactive power depending on the voltage $Q(U)$
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1.6 Active Power Control

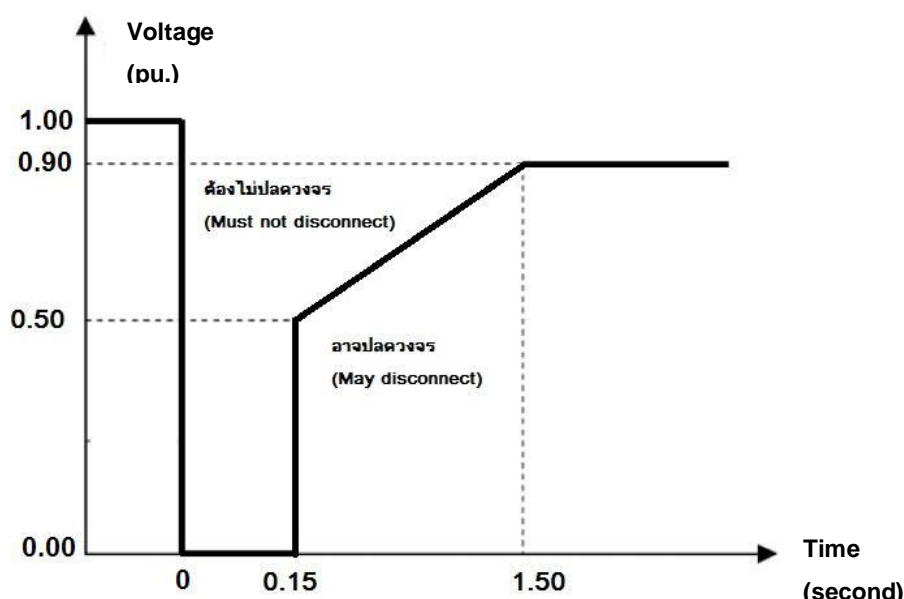
The power generating system of VSPP must be capable of reducing electric power from 100% to zero by decreasing 10% electric power per one minute. In this regard, if there is any abnormality occurred in the grid system or any incident considered by PEA as an impact affecting safety and stability of the grid system, PEA would inform and/or give an order to the VSPP to reduce electric power as appropriate.

1.7 Low Voltage Fault Ride Through

The power system of VSPP must not disconnect itself from the grid system within the required period during temporary low voltage of the grid system. The voltage at PCC is determined as shown in Table 2.

Table 2. Duration of Low Voltage Fault Ride Through

Voltage at PCC	Duration Time (Second)
1) Low voltage	Not required.
2) Moderate voltage or high voltage (electrical installation not exceeding 500 kilowatt).	
3) Moderate voltage or high voltage (electrical installation exceeding 500 kilowatt).	As shown in Picture 1.



Picture 1. Low Voltage Fault Ride Through

1.8 Under and Over Voltage Protection

The power system of VSPP must disconnect itself from the grid system if voltage level of line to neutral in the utility system is out of ranges as stated in Table 3.

Table 3. The Disconnect Duration of Falling Voltage Out of Rated Voltage Ranges

Voltage at PCC	Disconnect Duration (Second)
$V < 50\%$	0.3
$50\% \leq V < 90\%$	2.0
$90\% \leq V \leq 110\%$	continual voltage
$110\% < V < 120\%$	1.0
$V \geq 120\%$	0.16

1.9 Under and Over Frequency Protection

The power generating system of VSPP must disconnect itself from the grid system within 0.1 seconds if the frequency at PCC is not in the range of 48 Hz-51 Hz.

1.10 Anti-Islanding

In order to prevent anti-islanding while there is no electricity in grid system to be supplied to the power system of VSPP, the power generating system of VSPP must disconnect itself from the utility system within 2 seconds.

1.11 Response to Utility Recovery

After the power generating system of VSPP disconnect itself from the grid system because of power outage or voltage/frequency is out of the ranges, when the grid system is back to normal, the power system of VSPP must delay the time to reconnect itself to the grid system at a minimum of 20 seconds to 5 minutes.

2. Other Requirements

2.1 Earthing, short circuit protection, and isolation and switching must align with IEC 60364-7-712 standard.

2.2 Power quality monitoring in compliance with the Regulation of Grid Connection B.E.2551 stating that the VSPP must procure, design, and install monitoring systems for electrical quality which PEA can view real-time information through the Internet e.g. voltage, electrical current, frequency, electric power, power factor, THDv, THDi, Pst, and Plt. In addition, the VSPP must submit a monthly report of electrical quality monitoring certified by PQM in a form or format determined by PEA.

2.3 The VSPP who installs power system exceeding 56 kilowatt is required to have the monitoring systems of which real-time information can be viewed by PEA through the internet or applications e.g. electric power, electrical energy, sunlight intensity, and temperature.

2.4 In terms of connection to low voltage system of 380/220 KV

2.4.1 Total electrical installation of power system connected in LV distribution must not exceed 25% of transformer capacity) KVA)

2.4.2 If the total electrical installation of power system in 2.4.1 is connected at its maximum of 25% of transformer capacity, the power producer must connect it in a distribution system of which voltage is 22 or 33 KV. The power producer shall procure any distribution transformer and protector complying with a standard of PEA.

2.5 As for any VSPP who does not pass the technical requirements, the service applicants need to study and resolve occurred impacts. If the improvement to the grid system is required, the VSPP shall be responsible for incurred expenses. In this regard, PEA reserves the right to grant approval of connection to the grid system case by case.

2.6 PEA reserves the right to change technical requirements as appropriate primarily on a basis of safety and reliability of grid system and public benefits.

3. Test

3.1 Test Institute or Unit

1. The power generating system must pass a test from a laboratory approved by PEA
2. The laboratory must be certified ISO/IEC 17025:2005 which is a laboratory standard, or pass verifications conducted by impartial unit/institution in the country approved by PEA.
3. The power generating system that passes the test from the foreign laboratory shall be verified, and its test results shall be certified from impartial unit/institution in the country or PEA.

3.2 Test Categories

3.2.1 Laboratory Test

The test will be conducted by the institutes stated in item 3.1 and use only 1 unit per 1 model to confirm that if being applied, it will be capable of controlling electrical quality and responding to power system as determined by PEA. The tests shall be conducted under the following topics.

- (1) Harmonics
- (2) Voltage fluctuation
- (3) DC injection
- (4) Reactive power control and reactive power control methods
- (5) Active power control
- (6) Low voltage fault ride through
- (7) Under/over voltage protection
- (8) Under/over frequency protection
- (9) Anti-islanding
- (10) Response to utility recovery

3.2.2 Electrical Quality and Field Tests

Electrical quality and field tests conducted by PEA as follows:

- 1) Field test shall be conducted under the following topics.
 - (1) Anti-islanding
 - (2) Response to utility recovery
 - (3) Load rejection
- 2) Electrical quality test shall be conducted under the following topics.
 - (1) Voltage level
 - (2) Frequency
 - (3) Harmonics
 - (4) Voltage fluctuation

4. Procedure and Test Methodology

4.1 Harmonics Test

Refer to the suitable test method in IEEE or IEC standard

4.2 Voltage Fluctuation Test

Refer to the suitable test method in IEEE or IEC standard

4.3 DC Injection Test

Refer to the suitable test method in IEEE or IEC standard

4.4 Reactive Power Control

The test on reactive power control is conducted to affirm the maximum volume control in obtaining or supplying reactive power of power system. The minimal test procedures shall be conducted as follows:

- a) Install and connect the power generating system equipment as instruction and technical requirements from those equipment's manufacturers;
- b) Verify all parameters of power supply resource to function normally;
- c) Start the test by setting the power generating system at zero electric rating, then adjust the power system to supply reactive power to the system until it reaches its maximum, and record reactive power and power factor;

- d) Conduct the same test as in C) by setting the power generating system to supply electricity at 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100% of electric rating respectively, and record reactive power and power factor;
- e) Set the power system to start supplying electricity at zero electric rating, then adjust the power system to obtain reactive power into the system until it reaches its maximum, and record reactive power and power factor; and
- f) Conduct the same test as in e), but set the power system to supply electricity at 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100% of electric rating and record reactive power and power factor.
- g) From C) – F), the minimal test results shall be recorded due to the following table.

Table 4. A Sample of Test Result Record Table

P (Power System)	P (Measurable)	± Q (Measurable)	PF. (Measurable)
0%			
10%			
20%			
30%			
40%			
50%			
60%			
70%			
80%			
90%			
100%			

Nonetheless, other test methods that can prove the ability in obtaining or supplying maximum reactive power as stated in the regulations are referable.

4.4.1) A Fixed Displacement Factor $\cos \theta$

This test aims to affirm that the power generating system can control electricity supply in a mode of power factor control with stability. The minimal test procedures shall be as follows:

- a) Install and connect the power generating system equipment as instruction and technical requirements from those equipment's manufacturers;
- b) Verify all parameters of power supply resource to function normally;
- c) Set the power system to supply electricity at power factor setpoint equivalent to 0.90 lagging (or 0.95 lagging) while the power resource supplies electricity at 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100% of electrical rating respectively;
- d) Start the test and record the minimal test results as in the Table 5:
- e) Set the power system to supply electricity at power factor setpoint equivalent to 0.90 lagging (or 0.95 lagging) while the power resource supplies electricity at 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100% of electrical rating respectively;
- f) Start the test and record the minimal test results as in the Table 5:

- g) Set the power system to supply electricity at power factor setpoint equivalent to 1.0 while the power resource supplies electricity at 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100% of electrical rating respectively;
- h) Start the test and record the minimal test results as in the Table 5:

Table 5. A Sample of Test Result Record Table

P (Power System)	(Set) PF	P (Measurable)	Q (Measurable)	PF. (Measurable)
0%	0.90 lagging			
10%	0.90 lagging			
20%	0.90 lagging			
30%	0.90 lagging			
40%	0.90 lagging			
50%	0.90 lagging			
60%	0.90 lagging			
70%	0.90 lagging			
80%	0.90 lagging			
90%	0.90 lagging			
100%	0.90 lagging			

Table 6. A Sample of Test Result Record Table

P (Power generating system)	PF. (as specified)	P (as measured)	Q (as measured)	PF. (as measured)
0%	0.90 leading			
10%	0.90 leading			
20%	0.90 leading			
30%	0.90 leading			
40%	0.90 leading			
50%	0.90 leading			
60%	0.90 leading			
70%	0.90 leading			
80%	0.90 leading			
90%	0.90 leading			
100%	0.90 leading			

Nonetheless, other test methods that can prove the ability to control power distribution in static power factor mode as required in the regulation are referable.

4.4.2) A variable reactive power depending on the voltage Q(U) test

This is to confirm that the power generating system can control the power distribution in static voltage control mode. The minimum methods are as follow:

- a) Install and connect the power generating system equipment as instruction and technical requirements from those equipment's manufacturers;
- b) Verify all parameters of power supply resource to function normally;
- c) Set the power generating system to distribute power at Voltage Setpoint as in Table 7;
- d) Begin the test and record the number as in Table 7;
- e) Set the power generating system to distribute power at Voltage Setpoint as in Table 8; and
- f) Begin the test and record the number as in Table 8

Table 7. A Sample of Test Result Record Table

P, setpoint (%)	V, setpoint (Vac)	P (as measured)	V _{L1} (Vac)	V _{L2} (Vac)	V _{L3} (Vac)	Q (as measured) (Var)	Expected Q (Var)	Shifting Q (dQ)
Lower Limits								
<20	0.93Vn							
<20	0.91Vn							
20-30	0.91Vn							
40	0.91Vn							
50	0.91Vn							
60	0.91Vn							
70	0.91Vn							
80	0.91Vn							
90	0.91Vn							
100	0.91Vn							
100	0.90Vn							
100 – 10	0.90Vn							
10 - <5	0.90Vn							

Table 8. A Sample of Test Result Record Table

P, setpoint (%)	V, setpoint (Vac)	P (as measured)	V _{L1} (Vac)	V _{L2} (Vac)	V _{L3} (Vac)	Q (as measured) (Var)	Expected Q (Var)	Shifting Q (dQ)
Lower Limits								
<20	1.07Vn							
<20	1.09Vn							
20-30	1.09Vn							
40	1.09Vn							
50	1.09Vn							
60	1.09Vn							
70	1.09Vn							
80	1.09Vn							
90	1.09Vn							
100	1.09Vn							
100	1.10Vn							
100 – 10	1.10Vn							
10 - <5	1.10Vn							

Nonetheless, other test methods that can prove the ability to control power distribution in static voltage control mode as stated in the requirements are referable.

4.5 Active Power Control Test

This is a test of electric power control to test that the power generating system can control the electric power as follows:

1. Can reduce electric power at least 10% per minute
2. Can reduce the electric power every 10% of the rating while the power generating system does not lose connection to the grid system
3. The test method is as follows:
 - a) Install and connect the power generating system equipment as instruction and technical requirements from those equipment's manufacturers;
 - b) Verify all parameters of power supply resource to function normally;
 - c) Set the electric power control to reduce 10% from 100% of the electric power rating until 0% left and set other parts of power generating system to normal condition; and
 - d) Begin the test by having the power generating system distribute power at 100% of the electric power rating. After that, reduce the electric power as stated in c) then record the electric power number and time for each electric power reduction of the power generating system.

Nonetheless, other test methods that can prove the ability to control the electric power as stated in the requirements are referable.

4.6 Low Voltage Fault Ride Through Test

Low voltage fault Ride through test has steps as follow:

- a) Install and connect the power generating system equipment as instruction and technical requirements from those equipment's manufacturers;
- b) Verify all parameters of power supply resource to function normally;
- c) Set the low voltage fault ride through of the inverter set as specified in the requirement and set other parts of the inverter set to normal condition;
- d) Record the adjusted numbers;
- e) Begin the test by stimulating the low voltage fault (open circuit in the grid system stimulation) in the grid system to reduce voltage to between 70-80 percent, 30-50 percent and less than 5 percent of normal voltage;
- f) Record the highest duration time in which the power generating system can still connect to the grid system as in table 9; and
- g) Divide the test into different situations as in table 9

Table 9. A Sample of Test Result Record Table

Test List	V (V/Vn)	Duration Time (sec)
Three-phase faults	0.7-0.8 Vn	
	0.3-0.5 Vn	
	0-0.049 Vn	
Phase-phase faults	0.7-0.8 Vn	
	0.3-0.5 Vn	
	0-0.049 Vn	
Single line to ground faults	0.7-0.8 Vn	
	0.3-0.5 Vn	
	0-0.049 Vn	

Nonetheless, other test methods that can prove the ability to endure the low voltage fault as stated in the requirements are referable.

4.7 Under and Over Voltage Protection Test

In order to conduct the overvoltage and undervoltage test, the Trip Time Test has to be conducted at least as specified in these following tables.

Table 10. Over Voltage Response Test Method

Test Topics	Test Times	Test Process
Trip Time Test	(m)	<ol style="list-style-type: none"> (1) Install and connect the power generating system equipment as instruction and technical requirement from those equipment's manufacturers (2) Verify all parameters of power supply resource to function normally (3) Set overvoltage trip setting at test voltage number (see remarks, m) and set other settings normally (4) Record the adjusted number (5) Adjust AC distribution source voltage (utility stimulation) higher and close to overvoltage trip setting number, within 90% of overvoltage trip setting above but not higher, and maintain for 2 times of indicated time delay or longer (6) Adjust the voltage higher at least than 110% of overvoltage trip setting and remain until the power generating system equipment stops distributing power to the system (7) Record the time when the power generating system stops distributing power to the system

Table 11. Under Voltage Response Test Method

Test Topics	Test Times	Test Process
Trip Time Test	(m)	<ol style="list-style-type: none"> (1) Install and connect the power generating system equipment as instruction and technical requirements from those equipment's manufacturers (2) Verify all parameters of power supply resource to function normally (3) Set under voltage trip setting at test voltage number (see remarks, m) and set other settings normally (4) Record the adjusted number (5) Adjust AC distribution source voltage (utility stimulation) higher and close to under voltage trip setting number, within 110% of under voltage trip setting below but not under, and maintain for 2 times of indicated time delay or longer (6) Adjust the voltage lower at least than 90% of under voltage trip setting and remain until the power generating system equipment stops distributing power to the system (7) Record the time when the power generating system stops distributing power to the system
Remarks: m is the amount of under voltage that has to be tested twice.		

Remarks: A suitable test process by IEEE or IEC standard can be referred to.

4.8 Under and Over Frequency Protection Test

In order to conduct the overfrequency and underfrequency test, the Trip Time Test has to be conducted at least as specified in these following tables.

Table 12. Overfrequency Response Test Method

Test Topics	Test Times	Test Process
Trip Time Test	1 time	<ol style="list-style-type: none"> (1) Install and connect the power generating system equipment as instruction and technical requirements from those equipment's manufacturers (2) Verify all parameters of power supply resource to function normally (3) Set overfrequency trip setting at 51.1 Hz and set other settings of the power generating equipment normally (4) Record the adjusted number (5) Adjust AC distribution source frequency (utility stimulation) higher and close to overfrequency trip setting number, within 90% of overfrequency trip setting above but not higher, and maintain for 2 times of indicated time delay or longer (6) Adjust the frequency at least higher than 101% of overfrequency trip setting and remain until the inverter stops distributing power to the system (7) Record the time when the inverter stops distributing power to the system

Remarks: A suitable test process by IEEE or IEC standard is referable.

Table 13. Underfrequency Response Test Method

Test Topics	Test Times	Test Process
Trip Time Test	1 time	<ol style="list-style-type: none"> (1) Install and connect the power generating system equipment as instruction and technical requirements from those equipment's manufacturers (2) Verify all parameters of power supply resource to function normally (3) Set underfrequency trip setting at 47.9 Hz and set other settings of the power generating equipment normally (4) Record the adjusted number (5) Adjust AC distribution source frequency (utility stimulation) higher and close to underfrequency trip setting number, within 110% of underfrequency trip setting below but not under, and maintain for 2 times of indicated time delay or longer (6) Adjust the frequency at least lower than 99% of underfrequency trip setting and remain until the inverter stops distributing power to the system (7) Record the time when the inverter stops distributing power to the system

Remarks: A suitable test process by IEEE or IEC standard is referable.

4.9 Anti-islanding Protection Test

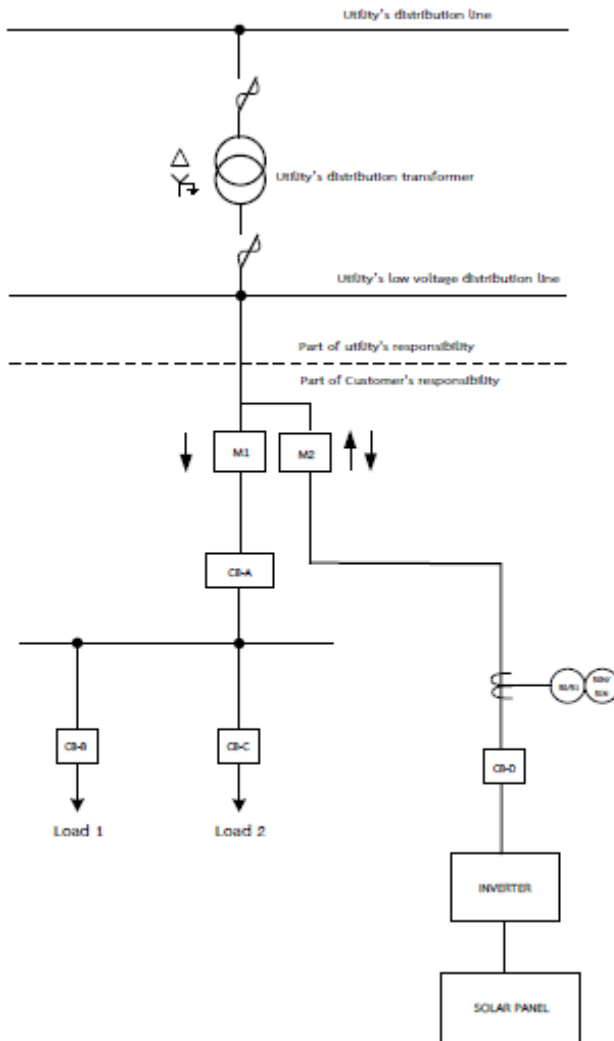
Refer to the suitable test method in IEEE or IEC standard.

4.10 Response to Utility Recovery Test

Refer to the suitable test method in IEEE or IEC standard.

5. Grid System Connection Format of the Provincial Electricity Authority

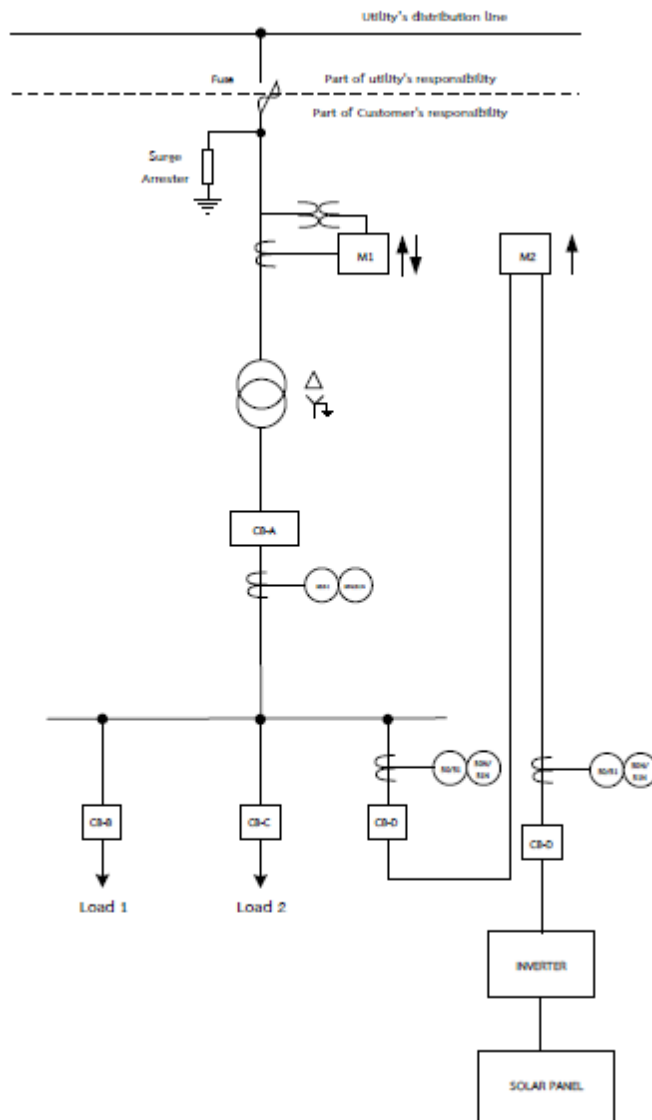
Format 1: Electric line connection standard (low volt meter users)



Remarks

1. M1 means meter that electric users bought from PEA.
2. M2 means meter for calculating power units produced from Solar Rooftop power generating system.
3. In case of personal transformer, the asset will be divided on load break switch.
4. In case that the power generating system of more than 250 kilowatt solar cell is being installed, 1 set of power quality meter has to be installed as well.
5. Solar rooftop generating system must not install energy storage/UPS in order to sell energy to PEA.

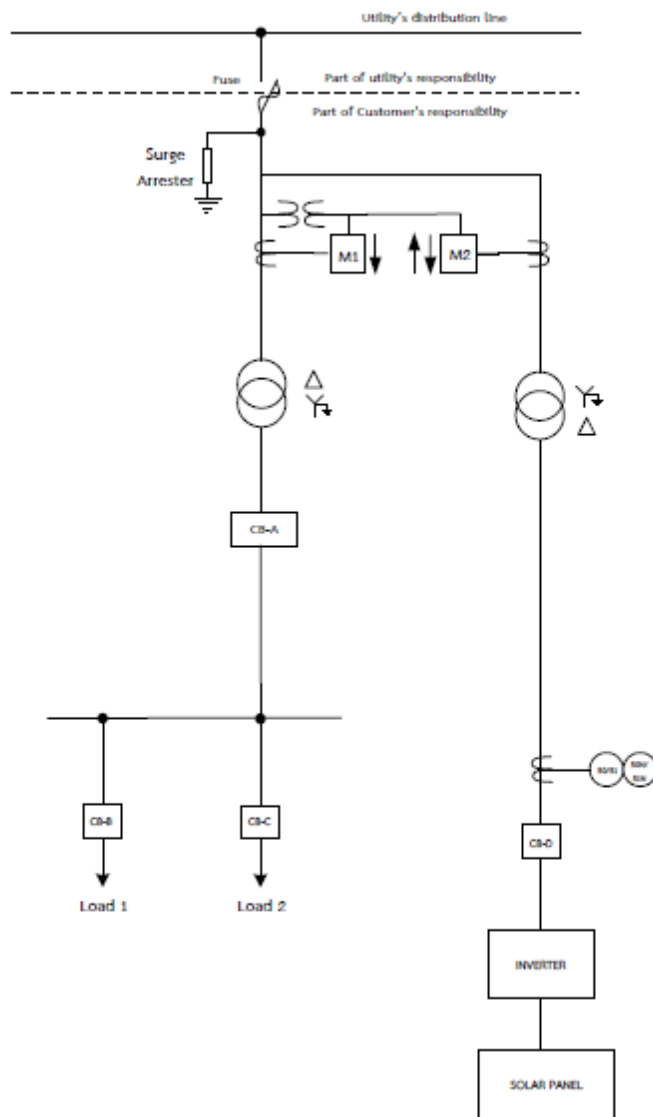
Format 2: Electric line connection standard (high volt meter users and sell power not over the rating of former transformer)



Remarks

6. M1 means meter that electric users bought from PEA.
7. M2 means meter for calculating power units produced from Solar Rooftop power generating system.
8. In case of personal transformer, the asset will be divided on load break switch.
9. In case that the power generating system of more than 250 kilowatt solar cell is being installed, 1 set of power quality meter has to be installed as well.
10. Solar rooftop generating system must not install energy storage/UPS in order to sell energy to PEA.

Format 3: Electric line connection standard (high volt meter users)



Remarks

11. M1 means meter that electric users bought from PEA.
12. M2 means meter for calculating power units produced from Solar Rooftop power generating system.
13. In case of personal transformer, the asset will be divided on load break switch.
14. In case that the power generating system of more than 250 kilowatt solar cell is being installed, 1 set of power quality meter has to be installed as well.
15. Solar rooftop generating system must not install energy storage/UPS in order to sell energy to PEA.

In case there is no proper connecting format or preventive equipment for VSPP, the Provincial Electricity Authority reserves the rights to consider the proper connecting format case by case.

Notification of the Department of Alternative Energy Development and Efficiency**on****Registration Criteria to be listed as Recommended Solar PV Rooftop Installers****and Invitation to File Registration Form**

Where as it is proper define registration criteria to be listed as recommended solar PV rooftop installers with appropriate qualifications to promote solar energy utilisation in power generation as in accordance with the Alternative Energy Development Plan 2012–2021 (AEDP 2012-2021), it is hereby announced as follows:

Clause 1 This Notification shall be called “Notification of the Department of Alternative Energy Development and Efficiency on Registration Criteria to be listed as Recommended Solar PV Rooftop Installers and Invitation to File Registration Form”.

Clause 2 This Notification shall come into force as from the day following the date of signing the Notification.

Clause 3 In this Notification,

“Installer” means a juristic person with appropriate qualifications who has been listed as a recommended solar PV rooftop installer.

“Department” means the Department of Alternative Energy Development and Efficiency.

“Director General” means Director General of the Department of Alternative Energy Development and Efficiency.

“Working Group” means working group whose responsibility is to examine whether a person filing a request to be listed as a recommended installer has appropriate qualifications as prescribed in this Notification.

Section 1

Installer Classification

Clause 4 Installer shall be classified into 2 types as follows:

Type A is a juristic person with paid up share capital not less than 2,000,000 baht (two million baht), 1 contract generating value of work not less than 1.0 million baht, and personnel according to Clause 11 who is qualified as solar PV rooftop installer with the installed capacity not exceeding 10 kilowatts (<10 kW_p).

Type B is a juristic person with paid up share capital not less than 10,000,000 baht (ten million baht), 1 contract generating value of work not less than 5.0 million baht, and personnel according to Clause 12 who is qualified as solar PV rooftop installer with the installed capacity not exceeding 1,000 kilowatts (<1,000 kW_p).

Section 2

Qualifications of A Person filing Registration Request

Clause 5 A person filing a request to be listed as recommended installer must

(1) be a juristic person incorporated in Thailand and has business objective to perform according to contract of work to build/install solar energy power generating system or power system or power plant or power distribution system;

(2) provide evidence of juristic person registration and supporting documents which at least must have the following

(2.1) in case of an ordinary partnership or juristic partnership; certified true copies of the certificate of juristic person registration; list of managing partners' names; and persons with controlling power (if any);

(2.2) in case of a limited company or public limited company; certified true copies of the certificate of juristic person registration; memorandum of association; list of managing directors' names; persons with controlling power (if any); and list of majority shareholders;

(2.3) certified true copies of commercial registration, value added tax registration, such juristic person's trade or business objectives;

(3) employ personnel as prescribed in Section 5;

(4) have completed and delivered work upon contract to build/install solar energy power generating system or power system or power plant or power distribution system where certificate of work issued by the hirer and a copy of work contract must be shown.

Section 3

Filing Registration Request Procedures

Clause 6 A person who intends to be listed as recommended installer must file a registration request to Director General by completing the registration form provided in the annex of this Notification together with evidence of juristic person registration and work performance according to Section 2 and evidence of personnel according to Section 5 employed by a person filing a request according to Clause 11 or Clause 12.

Clause 7 Henceforth, a person who intends to be listed can submit the request and all documents at the Department of Alternative Energy Development and Efficiency, No. 17 Kasatsuk Bridge, Pathumwan, Bangkok 10330 during office hours and can contact Bureau of Solar Energy Development, the Department of Alternative Energy Development and Efficiency on telephone 0 2221 9107, 0 2223 0021-9 extension 1472 or facsimile 0 2221 7841 for more information.

Section 4

Examination of Installer Registration Requests

Clause 8 Director General shall establish a Working Group to examine qualifications of a person filing a request to be listed as an installer who has submitted the specified request form and supporting documents listed in Section 2 and Section 5.

The Working Group shall take on its responsibilities from the day following the date of signing the working group establishment order by Director General.

Clause 9 When the Working Group selects appropriate qualified persons to be listed as recommended installers in accordance with this Notification, the list of qualified persons' names must be presented to Director General for approval in order to announce the list of recommended installers' names.

The list of the recommended installers shall be valid up to 2 (two) years from the date of signing of the announcement by Director General.

Clause 10 A person selected to be listed as recommended installer can file a request to extend the validity of its status at least 30 (thirty) days before the existing registration expires by submitting a letter to Director General confirming its qualifications together with other additional documents in case there are changes in qualifications as indicated in Section 2 and/or Section 5 (if any).

In case where the list becomes invalid, a person selected to be listed as in accordance with this Notification who intends to extend the validity of its status must proceed according to procedures prescribed in Clause 6.

Section 5

Personnel of an Installer

Clause 11 An installer, **Type A** shall have the following personnel:

(1) 1 Manager who controls and is responsible for works performed by operating employees in relation to area inspection, design and install solar PV rooftop system, and coordination among relevant persons. The Manager must have the following qualifications:

(a) Graduated at least with Bachelor Degree from educational institutions approved by the Office of the Civil Service Commission in:

(1) Engineering or equivalent in the fields of electrical engineering, or civil engineering, or structural engineering, or energy engineering, or construction engineering;

(2) Science in the fields of energy technology or energy management;

(3) Architecture or equivalent.

(b) Performed works or have experiences in managing projects related to building/installing solar energy power generating system or power system or power plant or power distribution system not less than 5 years by providing, for consideration, evidence of qualification, performed works, and experiences.

(2) Operating employees are responsible to inspect areas, design and make model of installation, install, monitor the installation, and test solar PV rooftop system. The operating employees comprise of:

(a) At least 1 electrical engineering with the following qualifications:

(a.1) Graduated at least Bachelor Degree in Engineering or equivalent in the field of electrical/power engineering from educational institution approved by the Office of the Civil Service Commission

and received License for Professional Practice from Council of Engineers that is valid on the date of signing the relevant documents;

(a.2) Performed works or have experiences in designing or installing solar energy power generating system or power system or related works on power electricity not less than 3 years by providing, for consideration, evidence of qualification, performed works, and experiences.

(b) At least 1 civil engineering with the following qualifications:

(b.1) Graduated at least Bachelor Degree in Engineering or equivalent in the field of civil engineering or structural engineering from educational institution approved by the Office of the Civil Service Commission and received License for Professional Practice from Council of Engineers that is valid on the date of signing the relevant documents;

(b.2) Performed works or have experiences in designing or constructing buildings or construction, installing solar energy power generating system or construction of power plant or power generating system not less than 3 years by providing, for consideration, evidence of qualification, performed works, and experiences.

(c) At least 1 electrical technician as follows:

Graduated with high vocational certificate from educational institution approved by the Office of the Civil Service Commission in the field of power electricity with experiences in installing solar energy power generating system or power generating system not less than 3 years by providing, for consideration, evidence of qualification, performed works, and experiences.

(d) At least 1 civil or construction technician as follows:

Graduated with high vocational certificate from educational institution approved by the Office of the Civil Service Commission in the field of civil or construction with experiences in construction or structure not less than 3 years by providing, for consideration, evidence of qualification, performed works, and experiences.

Clause 12 An installer, **Type B** shall have the following personnel:

(1) 1 Manager who controls and is responsible for works performed by operating employees in relation to area inspection, design and install solar PV rooftop system, and coordination among relevant persons. The Manager must have the following qualifications:

(a) Graduated at least with Bachelor Degree from educational institutions approved by the Office of the Civil Service Commission in:

(1) Engineering or equivalent in the fields of electrical engineering, or civil engineering, or structural engineering, or energy engineering, or construction engineering;

(2) Science in the fields of energy technology or energy management;

(3) Architecture or equivalent.

(b) Performed works or have experiences in managing projects related to building/installing solar energy power generating system or power system or power station or power distribution system not less than 5 years by providing, for consideration, evidence of qualification, performed works, and experiences.

(2) Operating employees are responsible to inspect areas, design and make model of installation, install, monitor the installation, and test solar PV rooftop system where it is required that the operating employees must sign no the documents under their own responsibilities. The operating employees comprise of:

(a) At least 1 electrical engineering with the following qualifications:

(a.1) Graduated at least Bachelor Degree in Engineering or equivalent in the field of electrical/power engineering from educational institution approved by the Office of the Civil Service Commission and received License for Professional Practice from Council of Engineers that is valid on the date of signing the relevant documents;

(a.2) Performed works or have experiences in designing or installing solar energy power generating system or power system or related works on power electricity not less than 5 years by providing, for consideration, evidence of qualification, performed works, and experiences.

(b) At least 1 civil engineering with the following qualifications:

(b.1) Graduated at least Bachelor Degree in Engineering or equivalent in the field of civil engineering or structural engineering from educational institution approved by the Office of the Civil Service Commission and received License for Professional Practice from Council of Engineers that is valid on the date of signing the relevant documents;

(b.2) Performed works or have experiences in designing or constructing buildings or construction, installing solar energy power generating system or construction of power plant or power generating system not less than 5 years by providing, for consideration, evidence of qualification, performed works, and experiences.

(c) At least 3 electrical technicians as follows:

Graduated with high vocational certificate from educational institution approved by the Office of the Civil Service Commission in the field of power electricity with experiences in installing solar energy power generating system or power generating system not less than 3 years by providing, for consideration, evidence of qualification, performed works, and experiences.

(d) At least 3 civil or construction technicians as follows:

Graduated with high vocational certificate from educational institution approved by the Office of the Civil Service Commission in the field of civil or construction with experiences in construction or structure not less than 3 years by providing, for consideration, evidence of qualification, performed works, and experiences.

Section 6

Withdrawal from the List of Recommended Installers

Clause 13 In case where it is appeared that a person on the list of recommended installers falls within the scope of Clause 15, the Working Group shall make a conclusion to withdraw such person from the list and present to Director General to ask for an approval in order to announce the withdrawal from the list and notify such person in writing accordingly.

Clause 14 Once listed on the list of recommended installers, if any installer does not fulfill the requirements on personnel provided in Section 5, such installer must notify Director General without delay.

The installer as in Paragraph 1 shall recruit new personnel in order to fulfill the requirements provided in Section 5 and notify Director General the names of new personnel within 30 (thirty) days from the date the lack of personnel notification received by Director General. Director General shall ask for approval on the new personnel from the Working Group and notify the installer accordingly.

Clause 15 The Working Group is authorised to withdraw an installer from the list of recommended installers if it is found that

(1) the installer does not fulfill qualifications as provided in Clause 4 or Clause 5 and or Section 5 unless the installer is in the process as in accordance with Clause 14;

(2) important information or documents provided at the time of filing the request to be on the list of recommended installers are incorrect;

(3) the installer does not follow regulation or criteria on solar PV rooftop installation provided by the relevant agencies.

Clause 16 Before withdrawing from the list of recommended installers according to 15, the Working Group shall examine facts and allow the installer to be notified of the allegation and provide other evidence and document against the allegation.

Section 7

Implementation

Clause 17 An installer requested to be on the list of recommended installers agrees to follow registration criteria to be listed as recommended solar PV rooftop installers, as well as to follow Director General's or the Working Group's decision.

Clause 18 This Notification shall be used by a relevant person as a guidance or recommendation in consideration of purchasing and installing solar PV rooftop.

Announced on 27th August 2013

Aumnuay Thongsatit

DirectorGeneral

The Department of Alternative Energy Development and Efficiency