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Interface and Commissioning Requirements for Grid Connection RE Systems

Ir Choi Chun Keung
Senior Customer Installation Engineer
HK Electric

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2. Commissioning Report and Inspection Prior to Grid Connection

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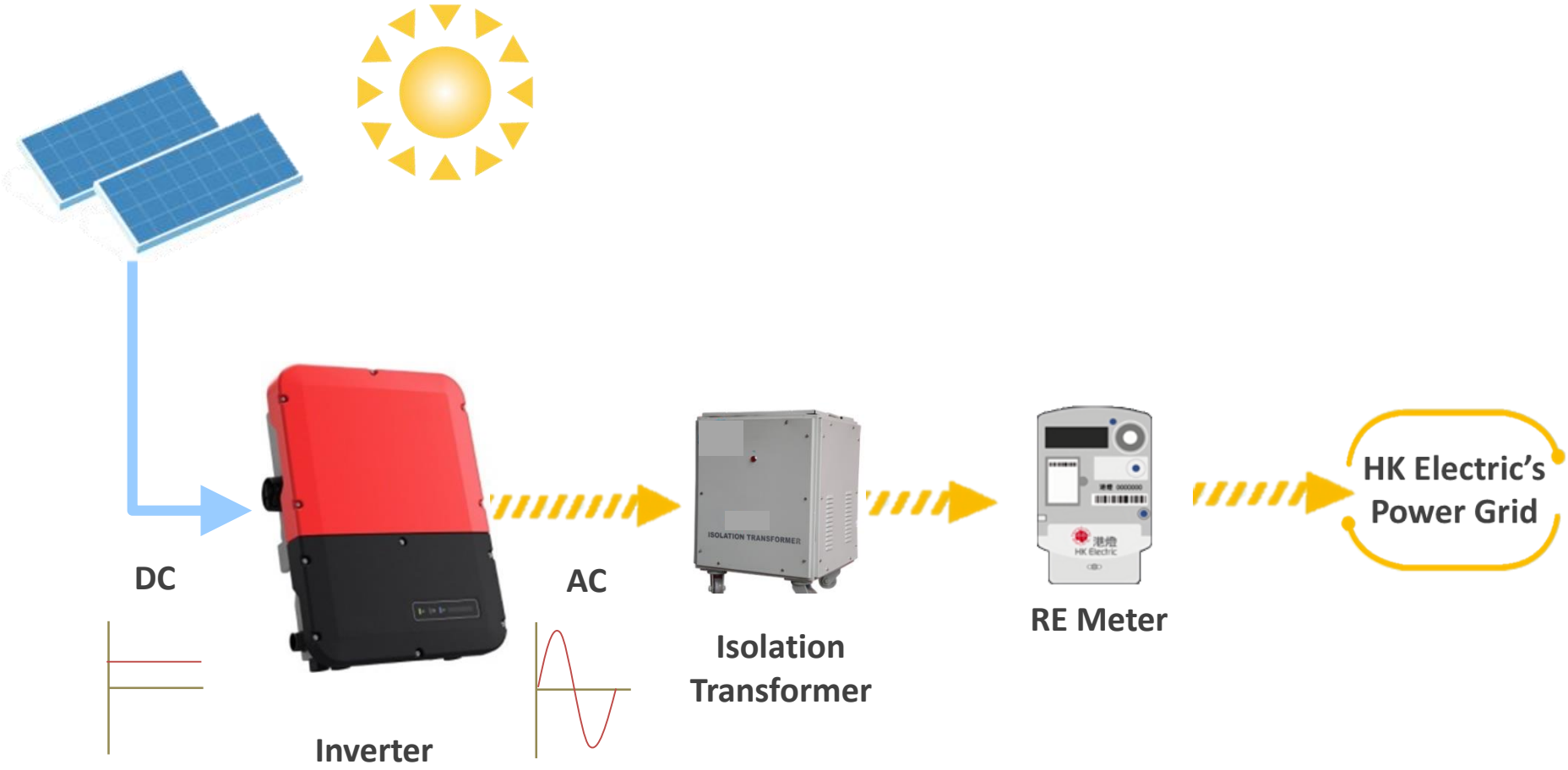
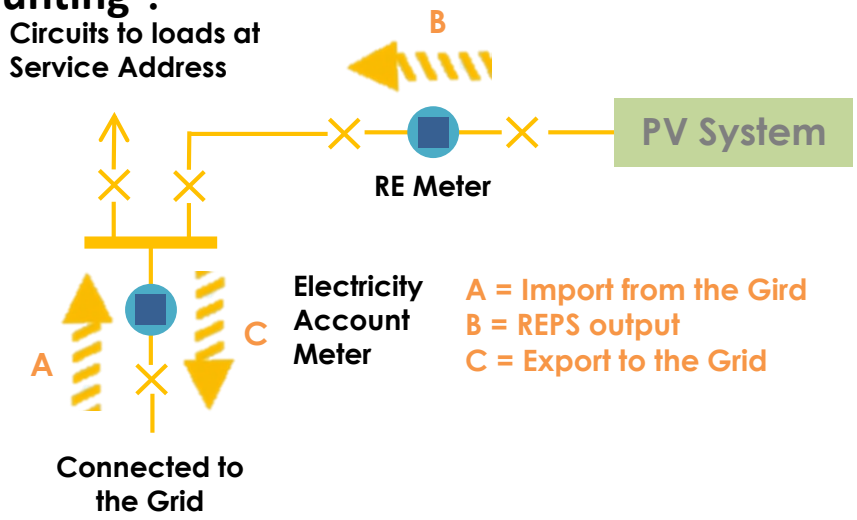
1. Interface Requirements for Grid Connection of RE System

Major Components for PV System：



1. Interface Requirements for Grid Connection of RE System

Metering and Accounting：



Payment/Charge	Calculation of Energy (in kWh)
FiT Payment	B x FiT Rate
Charges billed for consumption at Service Address	(A + B - C) x Prevailing Tariff

School Example	Normal Month	Low-usage Month
Import from the Grid	A = 2,000 kWh	A = 50 kWh
RESP Output (FiT)	**B = 500 kWh**	**B = 500 kWh**
Export to the Grid	C = 0 kWh	C = 100 kWh
Billed consumption	**A + B - C = 2,500 kWh**	**A + B - C = 450 kWh**

1. Interface Requirements for Grid Connection of RE System

General Electrical Requirements：

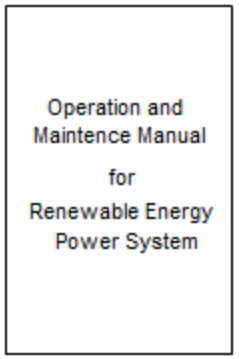
- HK Electric assesses application based on the impact of the proposed grid connection of REPS to HK Electric's supply reliability, supply limits and capacity, and with due consideration of the associated technical and safety requirements
- REPS are in general connected to 220/380V low-voltage electricity supply network
- In general, a REPS owner shall register the REPS as a **generation facility** with EMSD
- Anti-islanding function to automatically disconnect the REPS from the Grid in the event of de-energisation of the Grid within 2 seconds

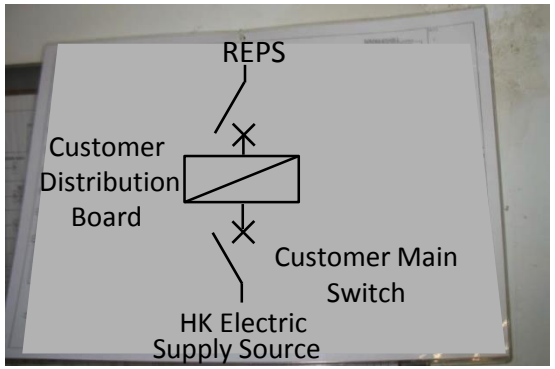
1. Interface Requirements for Grid Connection of RE System

Safety Requirement：

Operation and Maintenance Manual & Single-line Electrical diagrams of the REPS

- To facilitate responsible personnel to properly shut down the supply power from the REPS and grid under normal and emergency conditions
- To ensure the related electrical installations are totally isolated before the responsible personnel carrying out their works



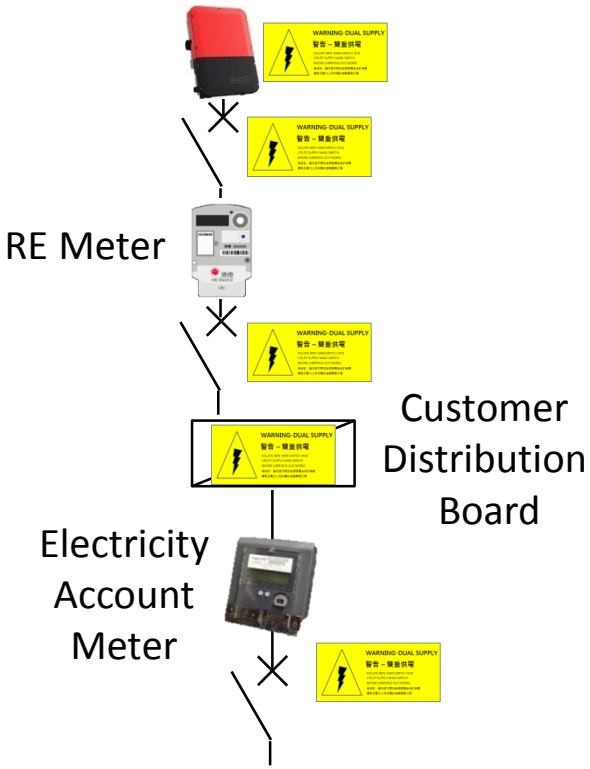


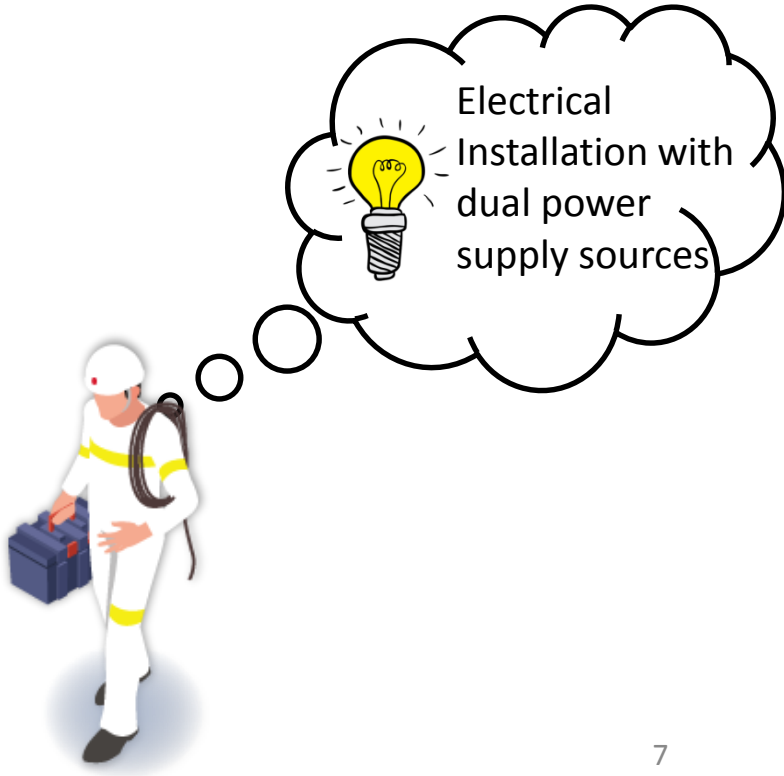
1. Interface Requirements for Grid Connection of RE System

Safety Requirement：

Dual Source Warning Label

- Display warning labels at all electrical equipment with dual power supply sources
- To alert the maintenance personnel





1. Interface Requirements for Grid Connection of RE System

Safety Requirement：

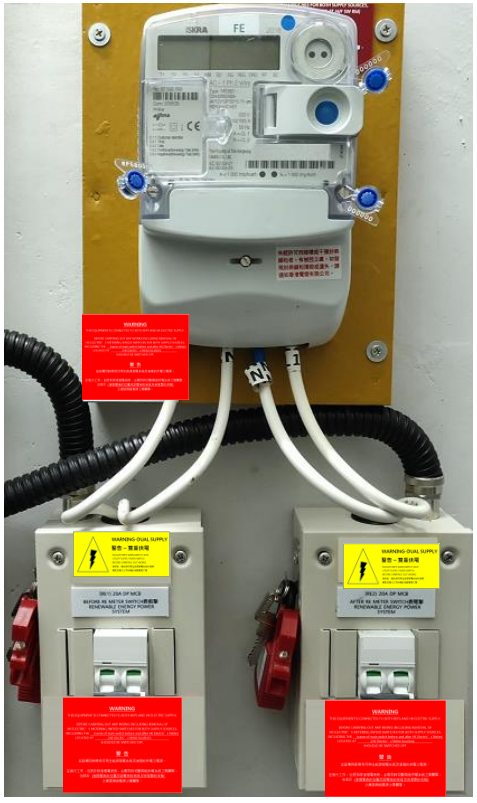
Dual Source Warning Label

- Existing Electricity Account Meter Board, Main Switch for the Existing Electricity Account Meter, RE Meter Board, Main Switches Before and After RE Meter shall display the warning label shown below:-

Electricity Account Meter

Main Switch for Electricity Account Meter

RE Meter



Main Switch after Meter

Main Switch before Meter

WARNING

THIS EQUIPMENT IS CONNECTED TO BOTH REPS AND HK ELECTRIC SUPPLY.

BEFORE CARRYING OUT ANY WORKS INCLUDING REMOVAL OF HK ELECTRIC' S METERING, INFEED SWITCHES FOR BOTH SUPPLY SOURCES, INCLUDING THE __(name of main switch before and after HK Electric' s Meter) LOCATED AT _____(HK Electric' s Meter location)_____ SHOUDLD BE SWITCHED OFF.

警 告

此設備同時帶有可再生能源發電系統及港燈的供電之電源。

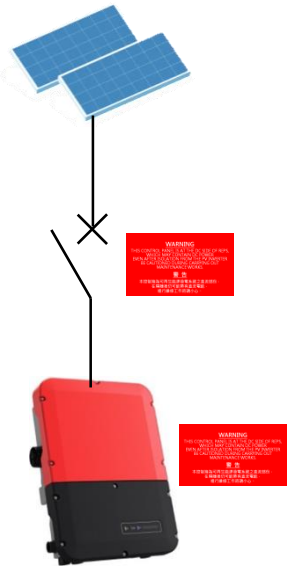
在進行工作，包括拆除港燈電表時，必需同時切斷兩組供電系統之開關掣，包括於 (港燈電表的位置及該電表的表前及表尾掣的名稱) 之連接兩組電源之開關掣。

1. Interface Requirements for Grid Connection of RE System

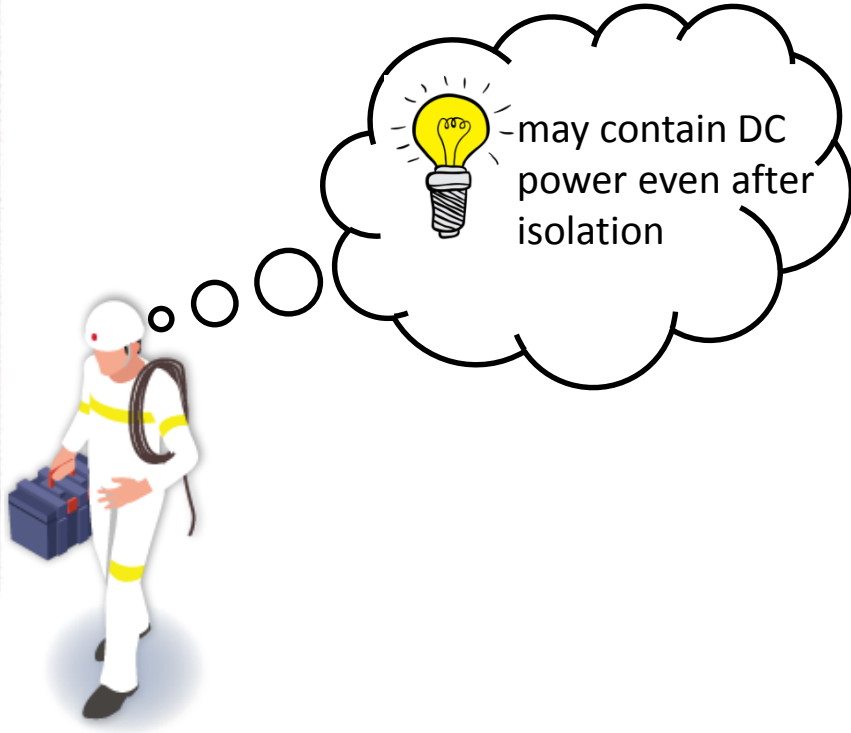
Safety Requirement：

DC warning Label

- To alert the maintenance personnel that the electrical equipment may contain DC power even after isolation from the PV inverter



DC switchgear



1. Interface Requirements for Grid Connection of RE System

Safety Requirement：

Communication Labels

- To allow the registered electrical worker to communicate directly with HK Electric under normal and emergency operations

可再生能源發電系統的地址
Address of the Renewable Energy Power System (REPS)

XXXXXXXX, XXXX Street, Hong Kong

接駁至港燈供電點:
Connected HK Electric's Supply Point :
供電號碼 SN 123456 （主電源）(Normal)
供電號碼 SN （第兩組的主電源）（如適用）(Backup) (if applicable)

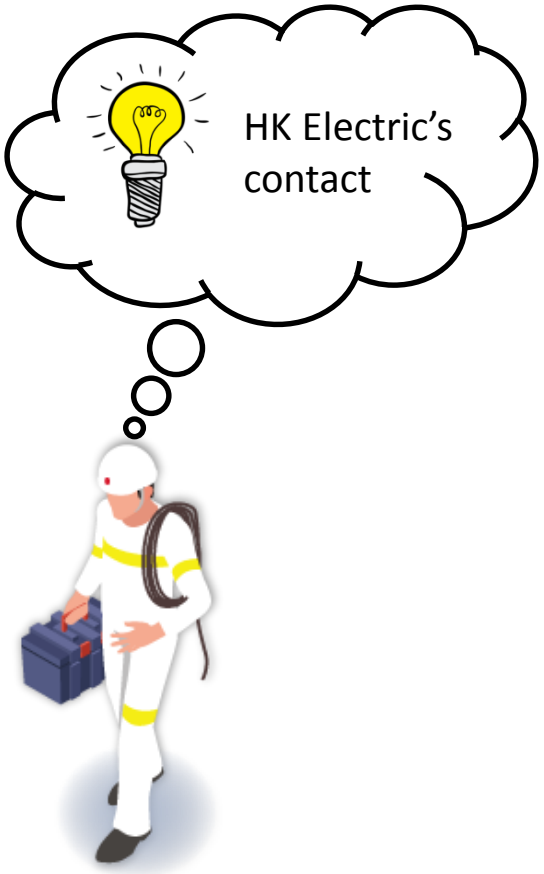
為確保上述可再生能源發電系統與電網能安全運作，系統擁有人指派的合資格人士在正常或緊急操作的情況下，可與香港電燈有限公司（港燈）直接聯絡。港燈的聯絡電話號碼如下:

To ensure the safe operation of the above REPS and the Grid, the qualified person designated by the owner may communicate directly with The Hongkong Electric Co., Ltd (HK Electric) under normal and emergency operations. HK Electric contact telephone no. is as follows:

港燈客戶緊急服務中心（二十四小時服務）
HK Electric Customers Emergency Services Centre (24-hour service)

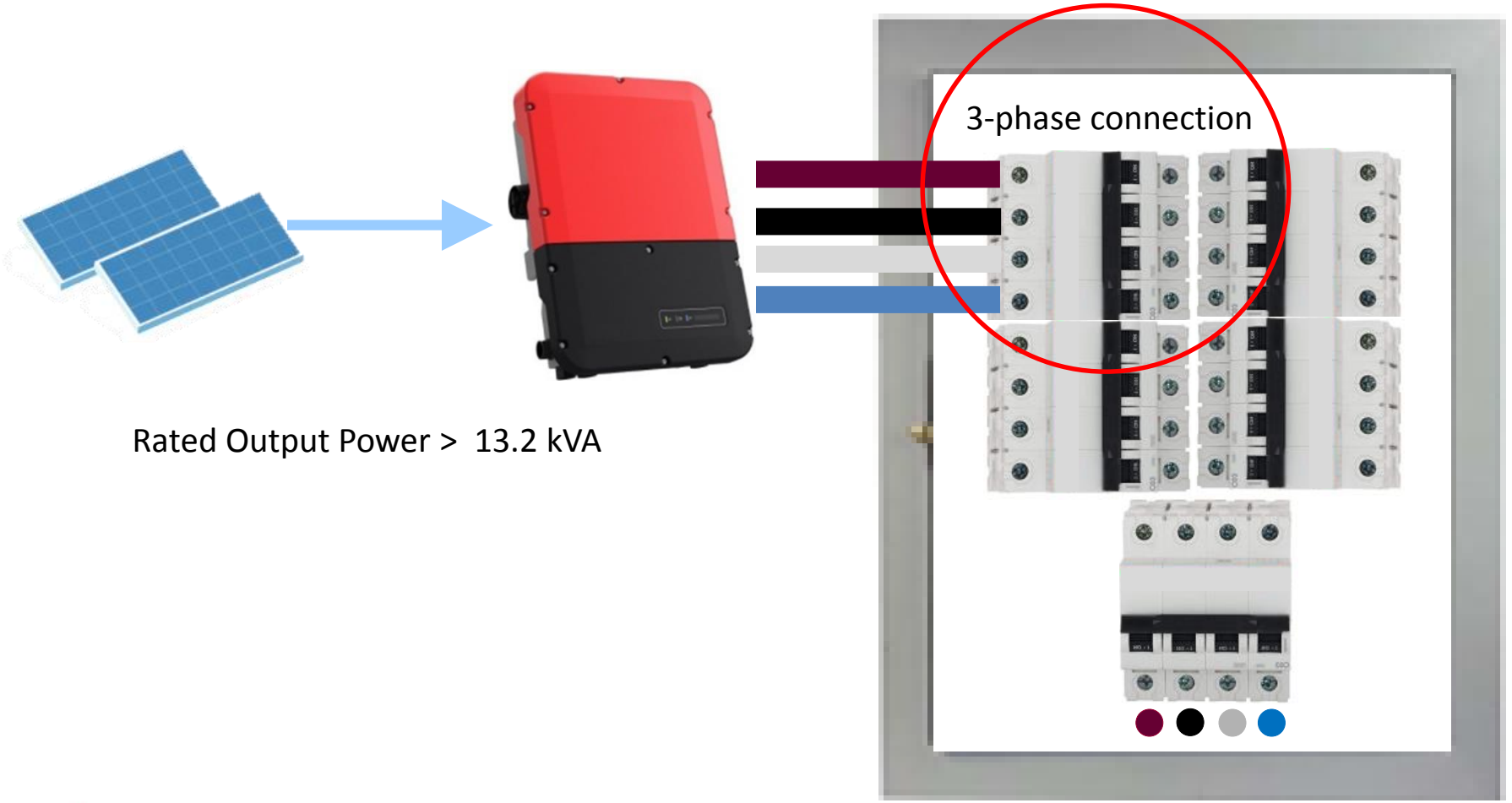
中文	電話號碼
Cantonese	Telephone No. 2555 4999
英文	電話號碼
English	Telephone No. 2555 4000

Main Incomer with SN



1. Interface Requirements for Grid Connection of RE System

Grid Connection Requirement：



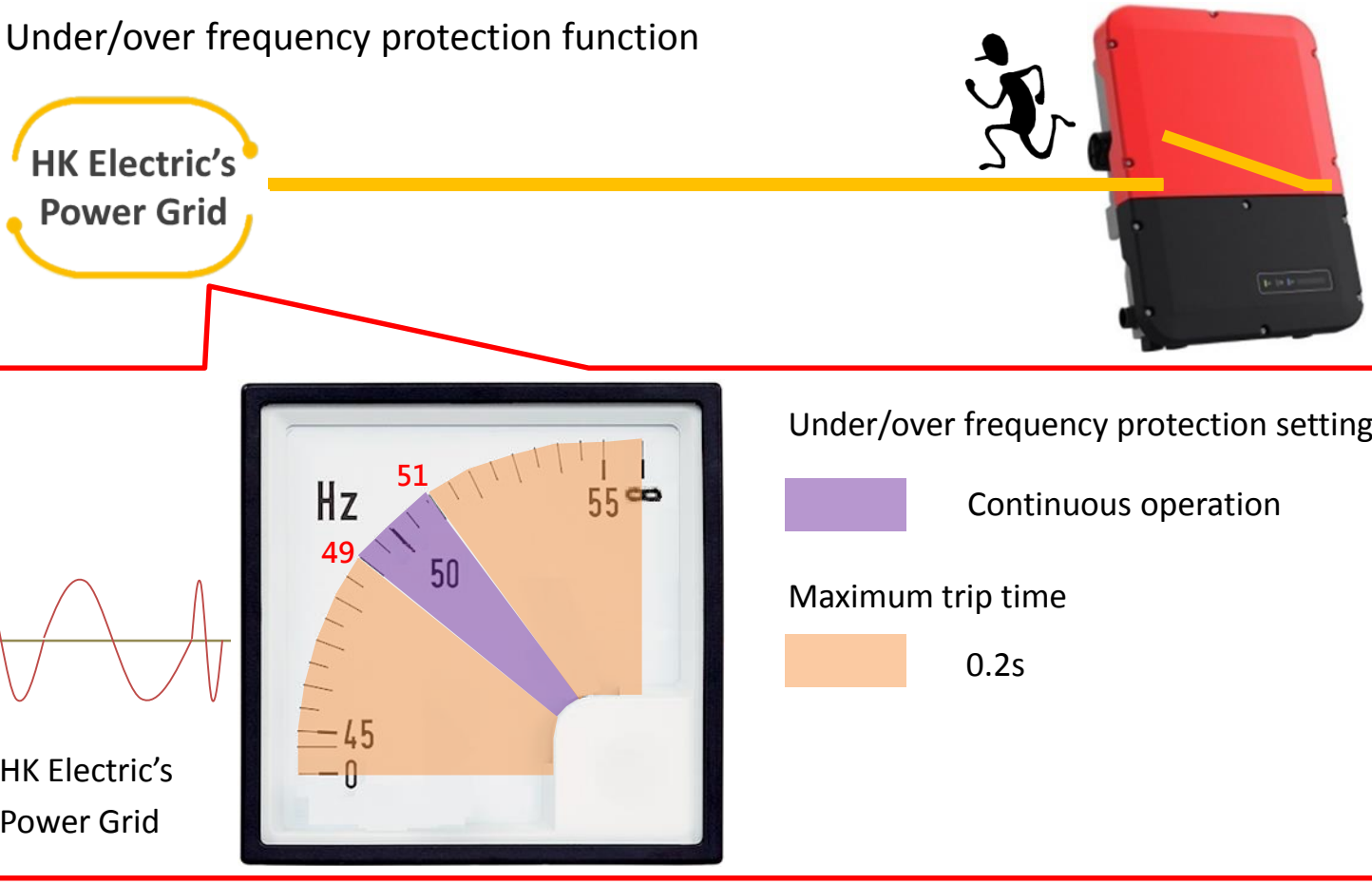
Rated Output Power > 13.2 kVA

Customer Distribution Board

1. Interface Requirements for Grid Connection of RE System

Grid Connection Requirement：

- Inverter should equipped with anti-islanding function, synchronisation check function, auto-reconnection function, power conditioning function and
- Under/over frequency protection function

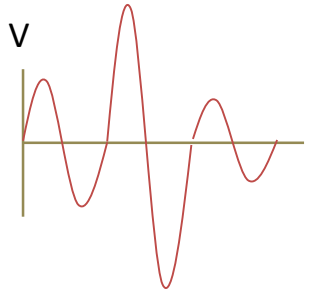


1. Interface Requirements for Grid Connection of RE System

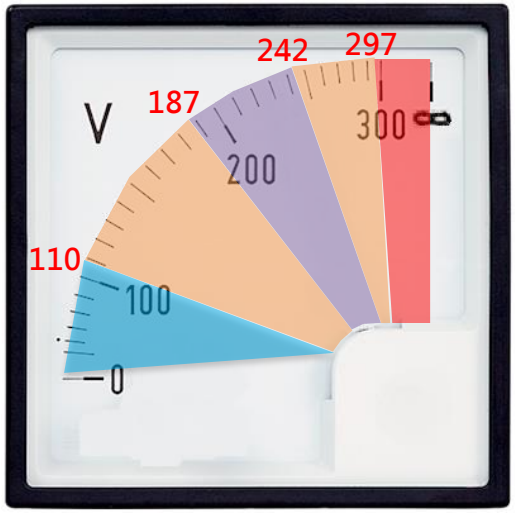
Grid Connection Requirement：

- Under/over voltage protection function

HK Electric's Power Grid



HK Electric's Power Grid



Under/over voltage protection setting

Continuous operation

Maximum trip time

2s

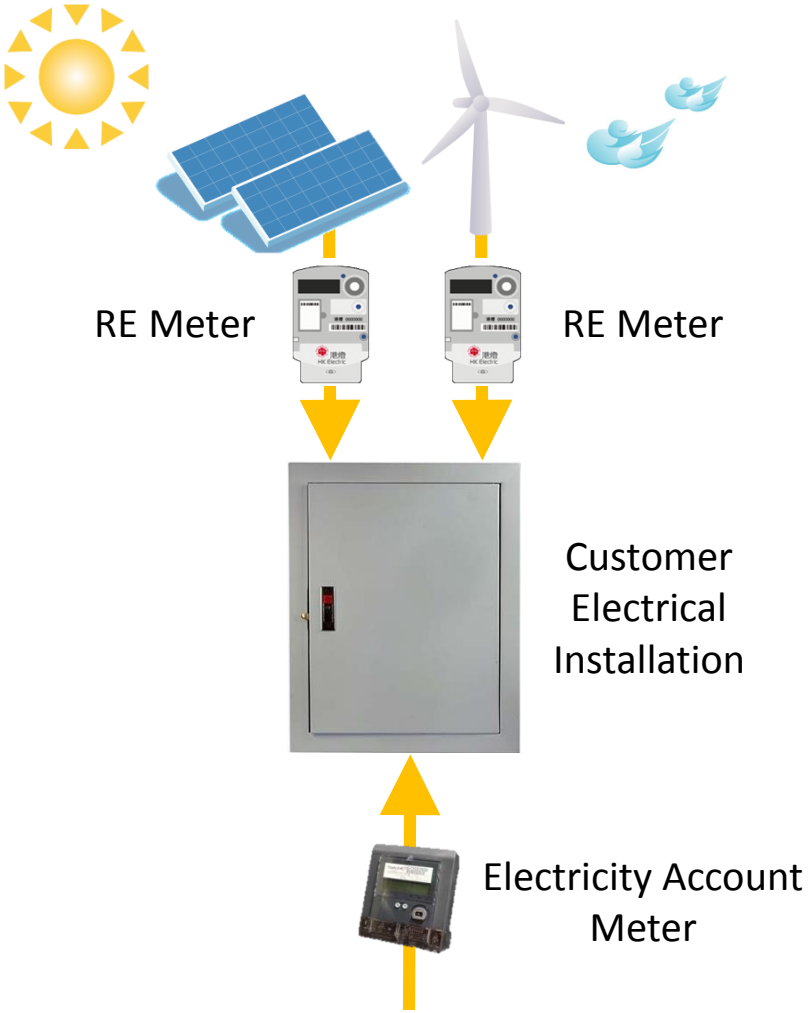
1s

0.05s

1. Interface Requirements for Grid Connection of RE System

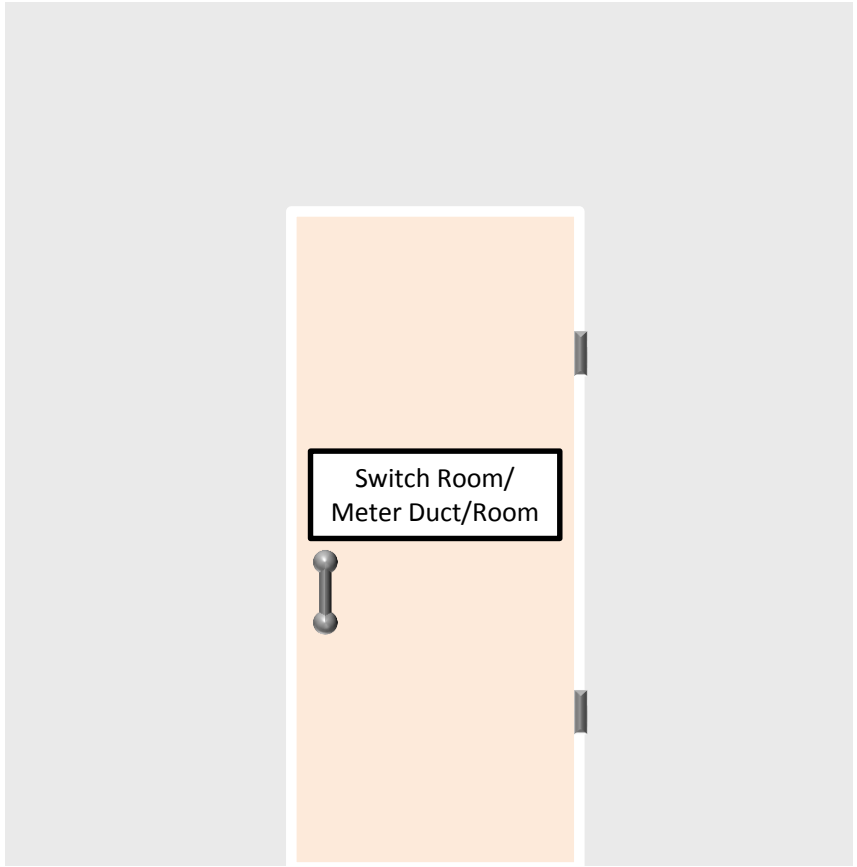
Renewable Energy (RE) Meter：

- Separate RE Meters shall be installed for REPS of different renewable energy technologies under same application:-



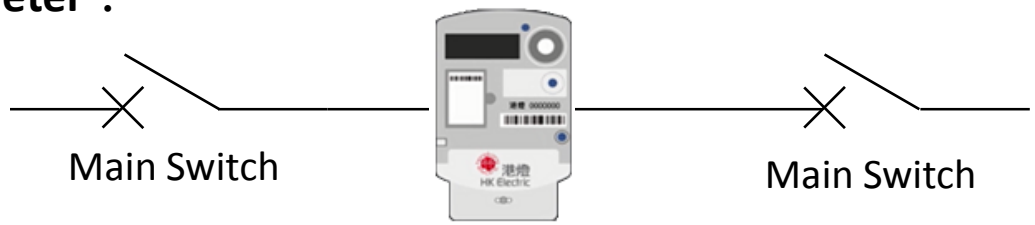
1. Interface Requirements for Grid Connection of RE System

RE Meter is required to be installed：



1. Interface Requirements for Grid Connection of RE System

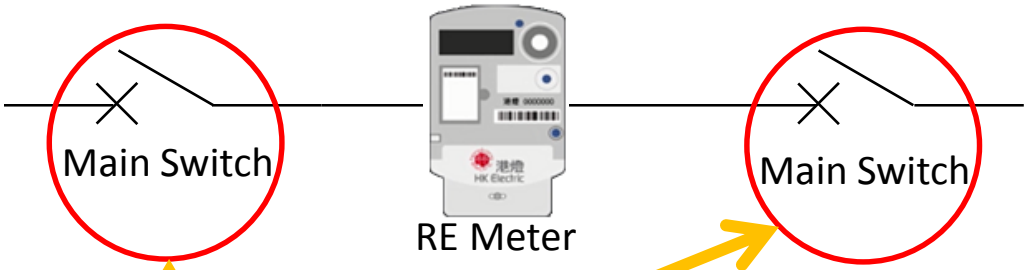
Type of RE Meter：



Main Switch Rating (A)	≤60A 1-Phase	≤100A 3-Phase	>100A 3-Phase
Meter Types	 1-Phase Whole Current Meter	 3-Phase Whole Current Meter	 C.T. Operated Meter

1. Interface Requirements for Grid Connection of RE System

Main Switches ：

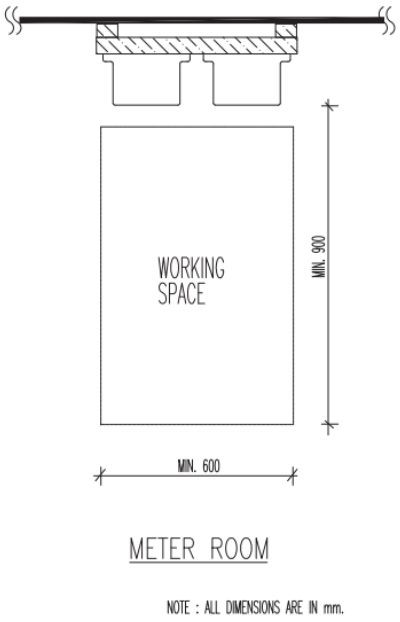
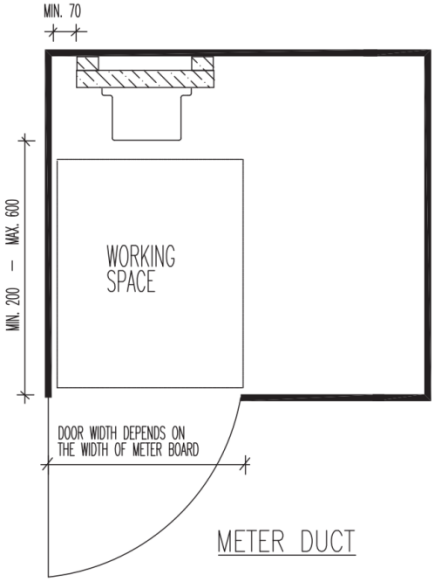


Main switches after meter and before meter:-

- Appropriate rating
- Lockable 
- With overcurrent and earth fault protection
- 4 Pole if 3-phase 
- Double Pole if 1-phase 

1. Interface Requirements for Grid Connection of RE System

Installation Requirement for the RE Meter：

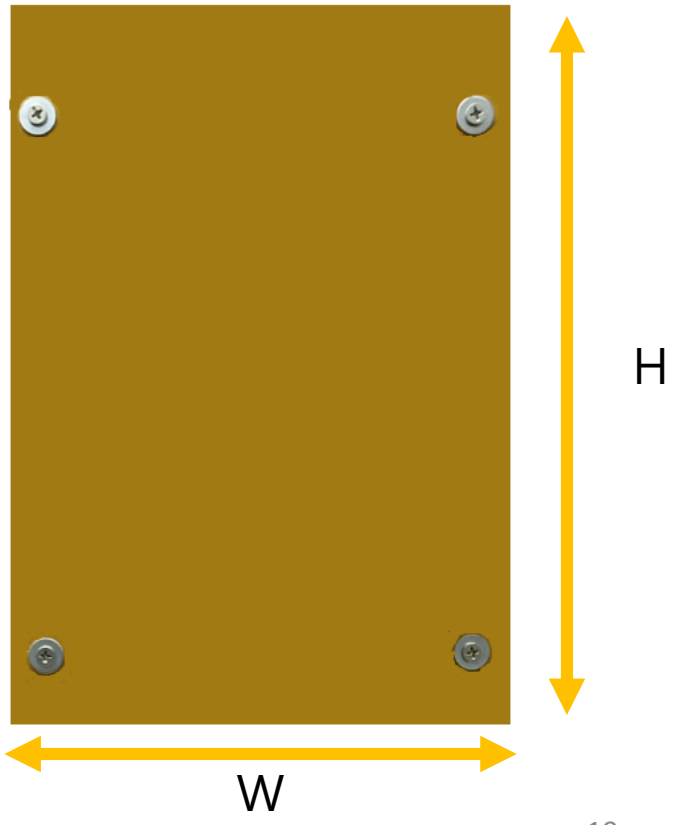
Installation Location	Meter Room	Meter Duct with no free working space inside
Requirement	• Minimum 70mm clearance on each side of the RE Meter • Minimum 900mm working space in front of the RE Meter 	• Minimum 70mm clearance on each side of the RE Meter • maximum 600mm and minimum 200mm distance between meter surface and the hinged door of the meter duct at closed position 

1. Interface Requirements for Grid Connection of RE System

Meter Board：

- Provided by the customer.
- Preferably be of hard wood with varnish treatment and at least 12 mm thick.
- Distance between the surface of meter board and wall surface shall not be less than 25 mm.

Meter Types	Dimensions	
	H	W
1-Phase Whole Current Meter	280	210
3-Phase Whole Current Meter	430	300
C.T. Operated Meter	480	300



1. Interface Requirements for Grid Connection of RE System

Fixing height of Meter Board：

- measured from the top of meter board to floor.

1. Interface Requirements for Grid Connection of RE System

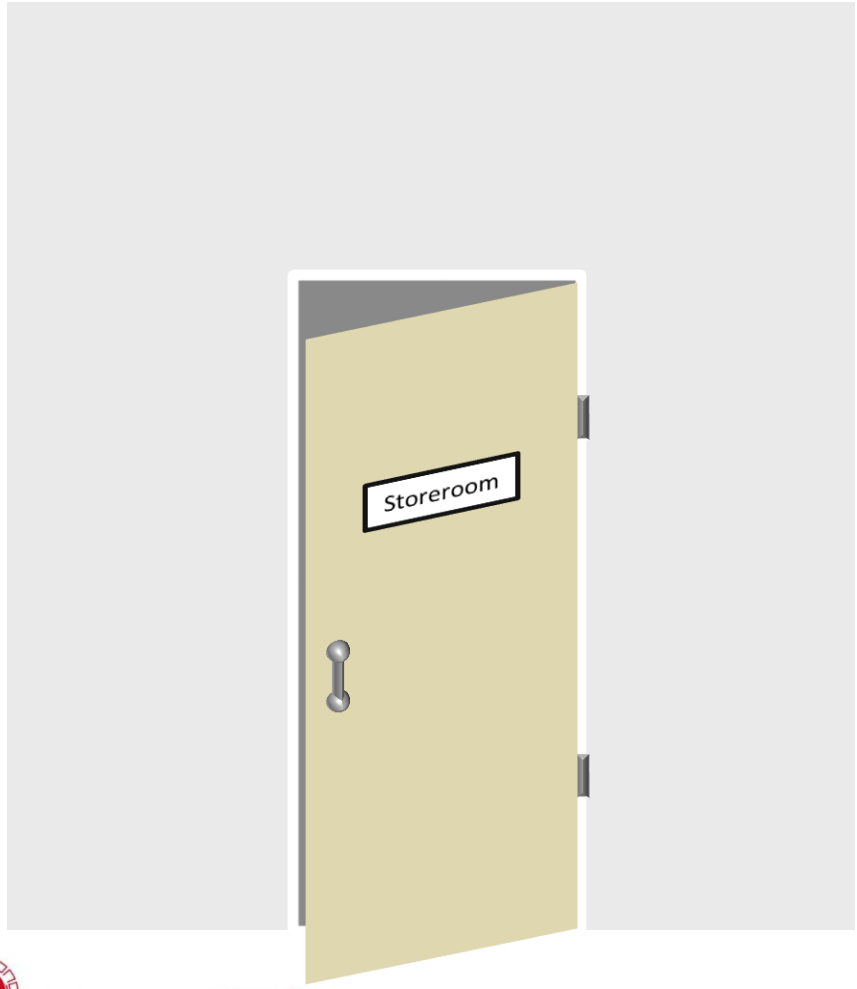
C.T. Operated Meter：

- Extra space should be provided for accommodating a C.T. cum link box

305 mm x 375 mm x 175 mm (H x W x D)

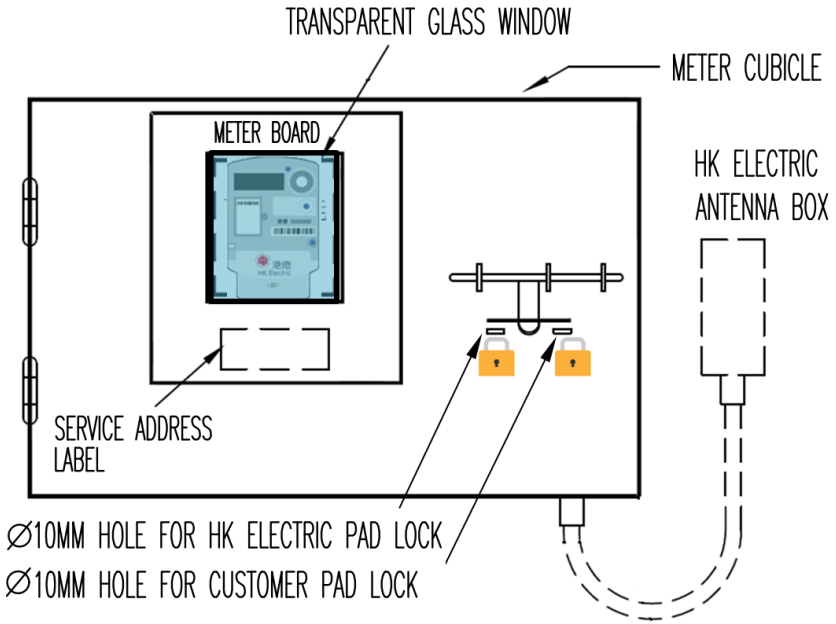
1. Interface Requirements for Grid Connection of RE System

RE Meter Cubicle：



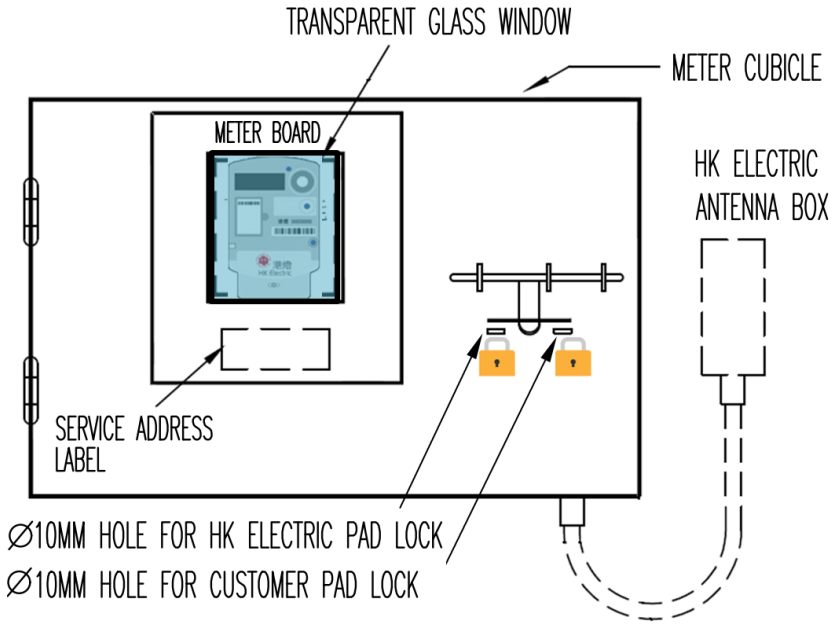
If the RE meter accommodation is accessible by anyone including unauthorised persons and persons without relevant qualifications:-

- Customer should have the right of use
- Required to provided and install a meter cubicle to house the RE meter



1. Interface Requirements for Grid Connection of RE System

RE Meter Cubicle ：



METER TYPES	MAIN SWITCH RATING (AMP)	MINIMUM CLEARANCE FOR METER TERMINATION	METER BOARD DIMENSIONS		METER CUBICLE DIMENSIONS	
		T	H	W	H(MC)	W(MC)
1 – ø	⩽ 60	150	280	210	355	350
3 – ø	⩽ 100	200	430	300	515	440
3 – ø	> 100	250	480	300	555	440

- Comply with the relevant Fire Services Department's requirements including the transparent glass window
- Maximum 50mm and minimum 20mm between meter surface to the hinged door at closed position
- Size of the meter cubicle shall be enlarged if other related electrical equipment to be installed inside the meter cubicle
- Installed at an easily accessible location/level
- Provide a plastic engraved label bearing words: "電表箱" and "Meter Cubicle" at the meter cubicle front cover
- Provide address label on the cubicle
- Distance between the surface of meter board and the transparent glass window of the RE Meter cubicle:-

Meter Types	Distance	
	Max	Min
1-Phase Meter	180	150
3-Phase Meter	220	190

1. Interface Requirements for Grid Connection of RE System

Existing Electricity Account Meter：

- Will be replaced, if:-

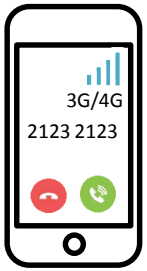
Customer Main Switch (>100 A 3-Phase)

Existing Electricity Account 3-Phase Whole Current Meter

Replace

C.T. Operated Meter

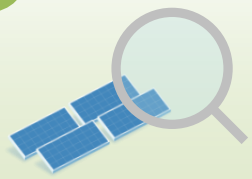
- Allow temporary suspension of electricity when necessary
- The location of the existing Electricity Account Meter shall be able to receive adequate 3G/4G signals



2. Commissioning Report and Inspection Prior to Grid Connection

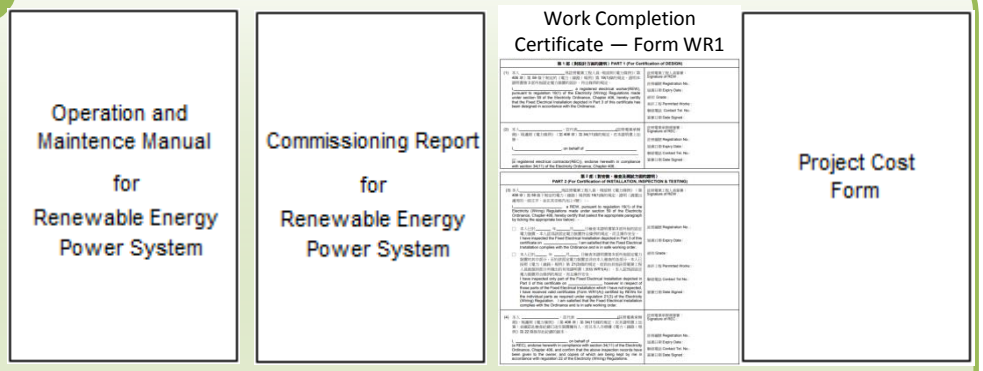
Inspection Arrangement：

1



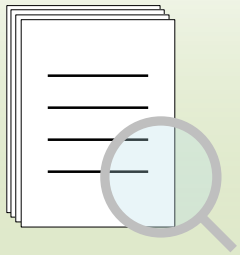
Registered Electrical Worker (REW) should be carried out a thorough inspection and functional/safety tests for the REPS

2



Submit the above documents to prove that the REPS has been properly installed, tested and commissioned, and is ready for connection to the Grid

3

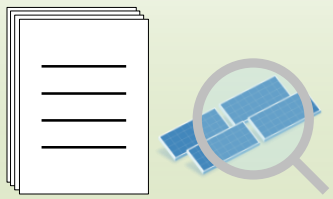


Upon satisfaction, HK Electric will arrange site inspection of the REPS

2. Commissioning Report and Inspection Prior to Grid Connection

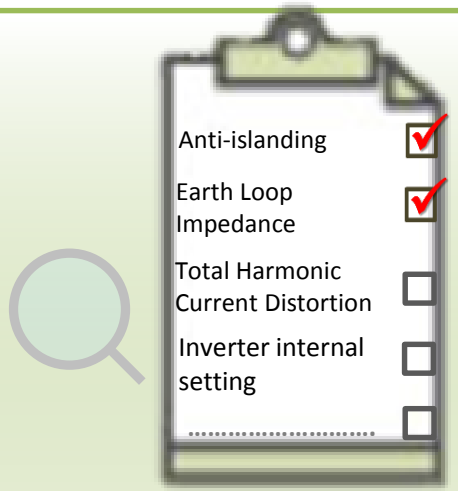
Site Inspection Arrangement：

1



Visual inspection to verify that the REPS as installed in accordance with the submitted documents

2



Witness the tests carried out by the REW

3

Upon satisfactory site inspection, HK Electric will install RE meter and replace existing electricity account meter

2. Commissioning Report and Inspection Prior to Grid Connection

Visual Inspection：

1. PV Panel/Wind Turbine

☑ Quantity

☑ Installation Location

☑ Technical Data

2. Commissioning Report and Inspection Prior to Grid Connection

Visual Inspection：

2. REPS installation (DC side)

DC Switchgears

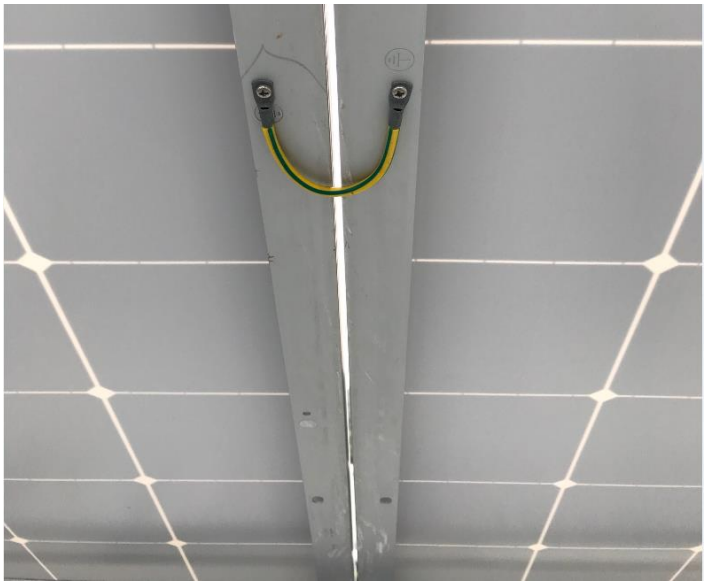
- ☑ Rating
- ☑ No. of pole

☑ DC warning label

2. Commissioning Report and Inspection Prior to Grid Connection

Visual Inspection：

3. Earthing Arrangement for REPS



☑ PV panels metallic frame to PV panels metallic frame

☑ PV panels metallic frame to PV panels metallic supporting frame

☑ PV panels metallic supporting frame to earthing terminal

2. Commissioning Report and Inspection Prior to Grid Connection

Visual Inspection：

4. REPS installation (Inverter side)

☑ Installation location

Technical data for inverter and isolation transformer

☑ Rating

☑ Quantity

AC switchgears

☑ Rating

☑ No. of pole

☑ Dual source warning label

2. Commissioning Report and Inspection Prior to Grid Connection

Visual Inspection：

4. REPS installation (Inverter side)

Display Notices for the employed REW / REC information of the power generation facilities

1. Owner / Representative of the REPS

Name of Owner / Representative	Title	Name of Contact Person	Phone No.	Address
Mr. Chan	Owner	Mr. Chan	9123 4567	XXXX, Hong Kong

2. Registered Electrical Contractor

Registered Electrical Contractor (REC) who is responsible for operation and maintenance of the REPS:

Company Name / Name of REC Representative	Registration No.	Expiry Date (DD/MM/YYYY)	Phone No.	Address
Smart RE	12345	20/11/2020	9123 4568	XXXX, Hong Kong

3. Registered Electrical Worker

Registered Electrical Worker (REW) who is responsible for operation and maintenance of the REPS:

Name of REW	Registration No.	Expiry Date (DD/MM/YYYY)	Grade	Permitted Work	Phone No.
Mr. Chan	12345	6/7/2020	C	0	9123 4569

Note: Please inform HK Electric if there is any change on the above information.

☑ Display notices for employed REW/REC information of generation facilities

☑ Circuit diagram

2. Commissioning Report and Inspection Prior to Grid Connection

Visual Inspection：

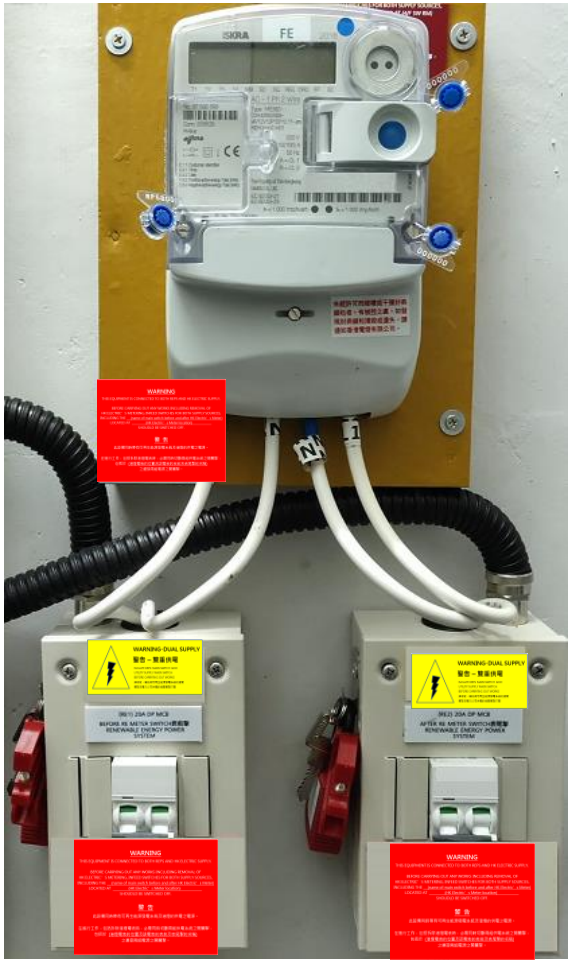
5. RE meter

Main switches for RE meter

- ☑ Rating
- ☑ 4-pole for 3-phase/ 2-pole for 1-phase
- ☑ Lockable facility
- ☑ Dual source warning label

Metering arrangement

- ☑ Meter board size
- ☑ Cable size
- ☑ Meter position
- ☑ Working clearance



2. Commissioning Report and Inspection Prior to Grid Connection

Visual Inspection：

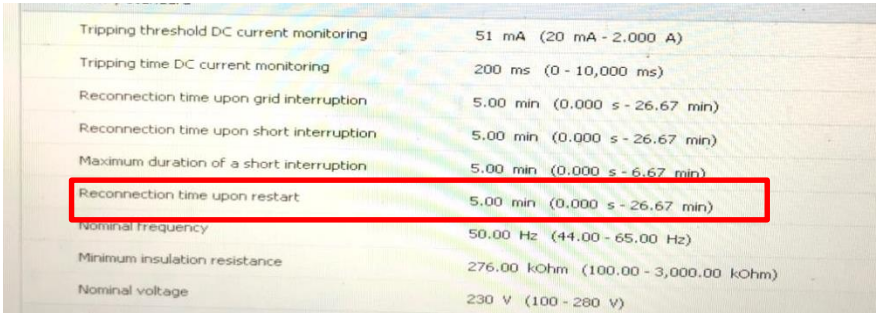
6. HK Electric Supply Point

- ☑ Updated main electrical schematic diagram including the REPS
- ☑ Confirm the electricity account meter and SN
- ☑ Dual power supply warning label
- ☑ Communication label

2. Commissioning Report and Inspection Prior to Grid Connection

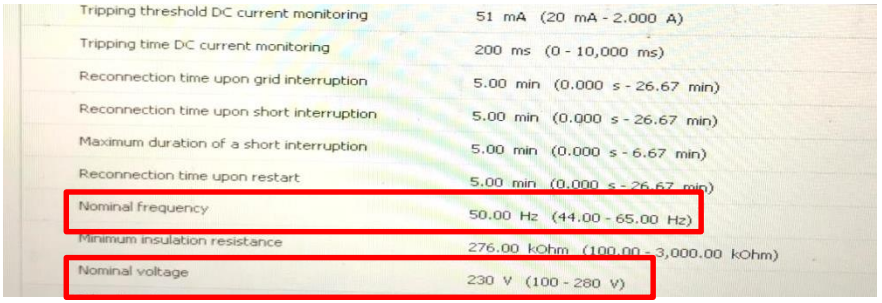
Witness the tests carried out by the REW ：

☑ Check the internal setting of the inverter to comply with technical requirement



Tripping threshold DC current monitoring	51 mA (20 mA - 2.000 A)
Tripping time DC current monitoring	200 ms (0 - 10,000 ms)
Reconnection time upon grid interruption	5.00 min (0.000 s - 26.67 min)
Reconnection time upon short interruption	5.00 min (0.000 s - 26.67 min)
Maximum duration of a short interruption	5.00 min (0.000 s - 6.67 min)
Reconnection time upon restart	5.00 min (0.000 s - 26.67 min)
Nominal frequency	50.00 Hz (44.00 - 65.00 Hz)
Minimum insulation resistance	276.00 kOhm (100.00 - 3,000.00 kOhm)
Nominal voltage	230 V (100 - 280 V)

☑ Reconnection time (at least 5 minutes)



Tripping threshold DC current monitoring	51 mA (20 mA - 2.000 A)
Tripping time DC current monitoring	200 ms (0 - 10,000 ms)
Reconnection time upon grid interruption	5.00 min (0.000 s - 26.67 min)
Reconnection time upon short interruption	5.00 min (0.000 s - 26.67 min)
Maximum duration of a short interruption	5.00 min (0.000 s - 6.67 min)
Reconnection time upon restart	5.00 min (0.000 s - 26.67 min)
Nominal frequency	50.00 Hz (44.00 - 65.00 Hz)
Minimum insulation resistance	276.00 kOhm (100.00 - 3,000.00 kOhm)
Nominal voltage	230 V (100 - 280 V)

☑ Nominal frequency [50Hz (±2%)]

☑ Nominal voltage [220V / 380V (±6%)]

Median maximum threshold	297.00 V
Median maximum threshold tripping time	50 ms
Lower maximum threshold	242.00 V
Lower maximum threshold tripping time	2,000 ms
Upper minimum threshold	187.00 V
Upper minimum threshold tripping time	2,000 ms
Median minimum threshold	110.00 V
Median minimum threshold tripping time	100 ms
Upper maximum threshold as RMS value	264.50 V
Upper max threshold as RMS value for tripping time	200 ms

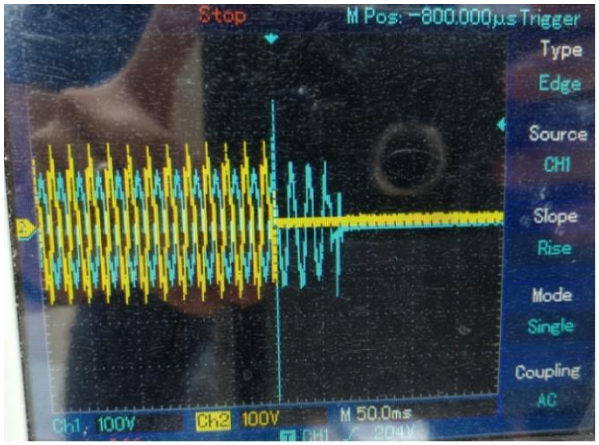
Frequency monitoring

Median maximum threshold	51.00 Hz
Median maximum threshold tripping time	200 ms
Lower maximum threshold	51.00 Hz
Lower maximum threshold tripping time	200 ms
Upper minimum threshold	49.00 Hz
Upper minimum threshold tripping time	200 ms
Median minimum threshold	49.00 Hz
Median minimum threshold tripping time	200 ms

☑ Maximum trip time for automatic disconnection when sustained voltage and frequency fluctuations (as stated in the Technical Requirement)

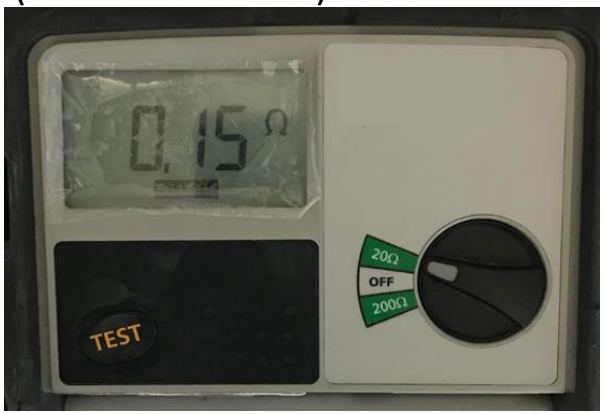
2. Commissioning Report and Inspection Prior to Grid Connection

Witness the tests carried out by the REW ：



☑ Anti-islanding functional test (within 2 seconds)

☑ Total harmonic current distortion (not exceed 5%)



☑ Earth loop impedance (comply with COP)

☑ RCD function test (if applicable)

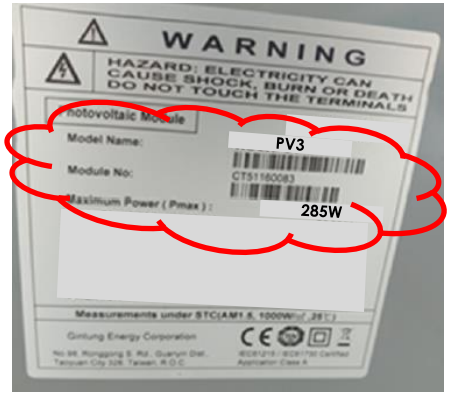
3. Common Departures

On-site installation mismatch with the submitted technical data:-

Electrical Characteristics

Model	PV1	PV2	PV3
Maximum Power (Pmax)[W]	275	280	285
Maximum Power Voltage (Vmp)[V]	30.49	30.63	30.78
Maximum Power Current (Imp)[A]	9.02	9.14	9.26
Open Circuit Voltage (Voc)[V]	38.19	38.35	38.46
Short Circuit Current(Isc)[A]	9.40	9.52	9.65
Temperature Coefficient of Pmax [%/K]	-0.4033	-0.4033	-0.4033
Temperature Coefficient of Voc [%/K]	-0.2960	-0.2960	-0.2960
Temperature Coefficient of Isc [%/K]	0.0540	0.0540	0.0540
Series Fuse [A]	15	15	15
Maximum System Voltage[V DC]	1,000	1,000	1,000
NOCT	45±2℃	45±2℃	45±2℃

Submitted Technical Data for PV Panel



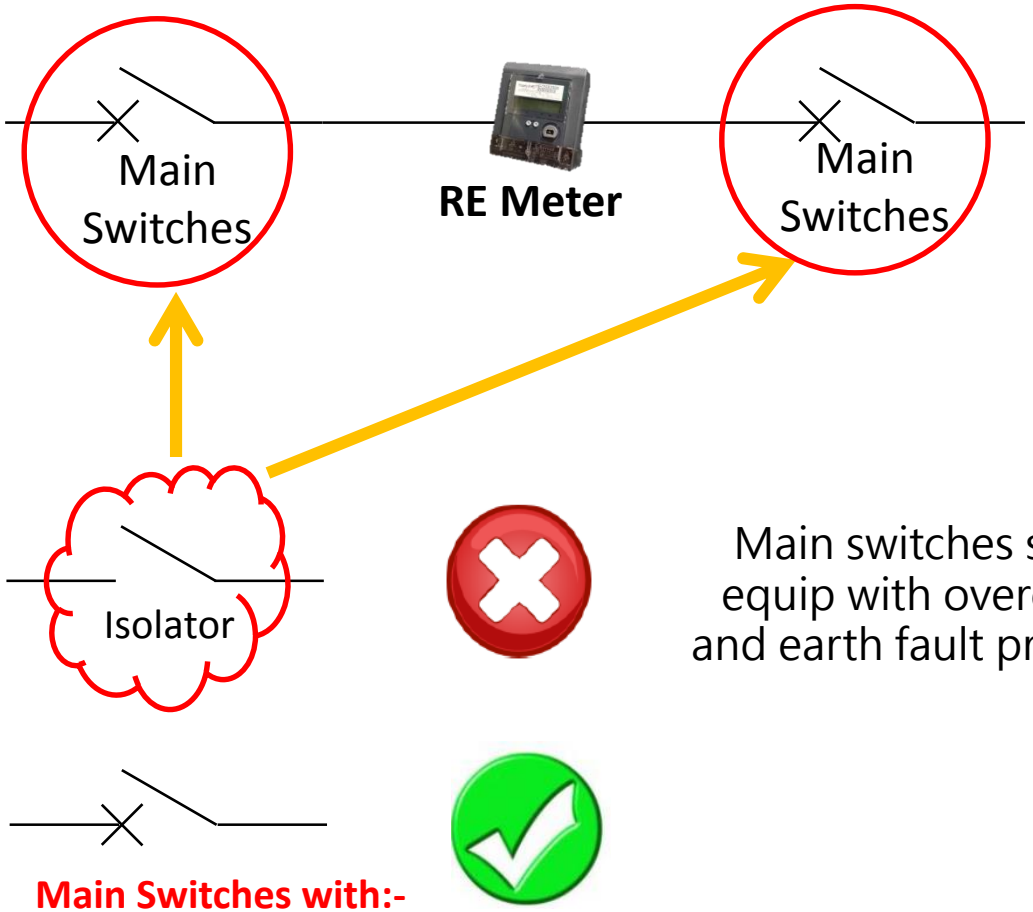
On-site installation

Mismatch

On-site installation

3. Common Departures

Main Switches for RE Meter:-



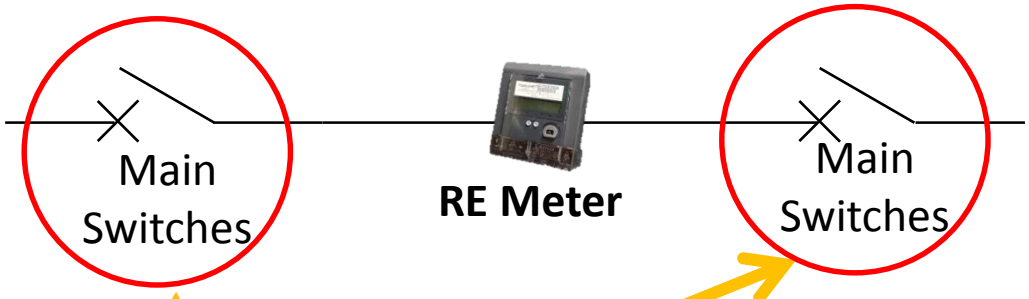
Main switches should equip with overcurrent and earth fault protection

Main Switches with:-

- **Overcurrent protection**
- **Earth fault protection**

3. Common Departures

Main Switches for RE Meter:-



Main switches should be lockable

3. Common Departures

Requirement for Whole Current Meter's Meter Leads/Tails :-

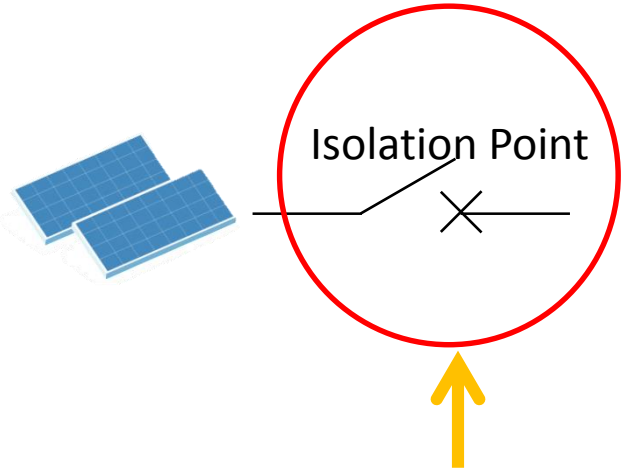
2.5 sq. mm stranded copper conductor

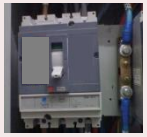
Minimum size of conductors used for termination onto whole current type meter shall be 4 sq. mm stranded copper conductor

Min. 4 sq. mm stranded copper conductor

3. Common Departures

Isolation Point:-

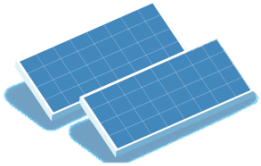


REPS	Isolation Point	
1-phase	 Single-Pole 	 **Double**-Pole 
3-phase	  Triple-Pole/Triple-Pole & Neutral 	 **4**-Pole 

allow complete isolation from the Distribution System when the REPSs is not in service

3. Common Departures

Inverter:-



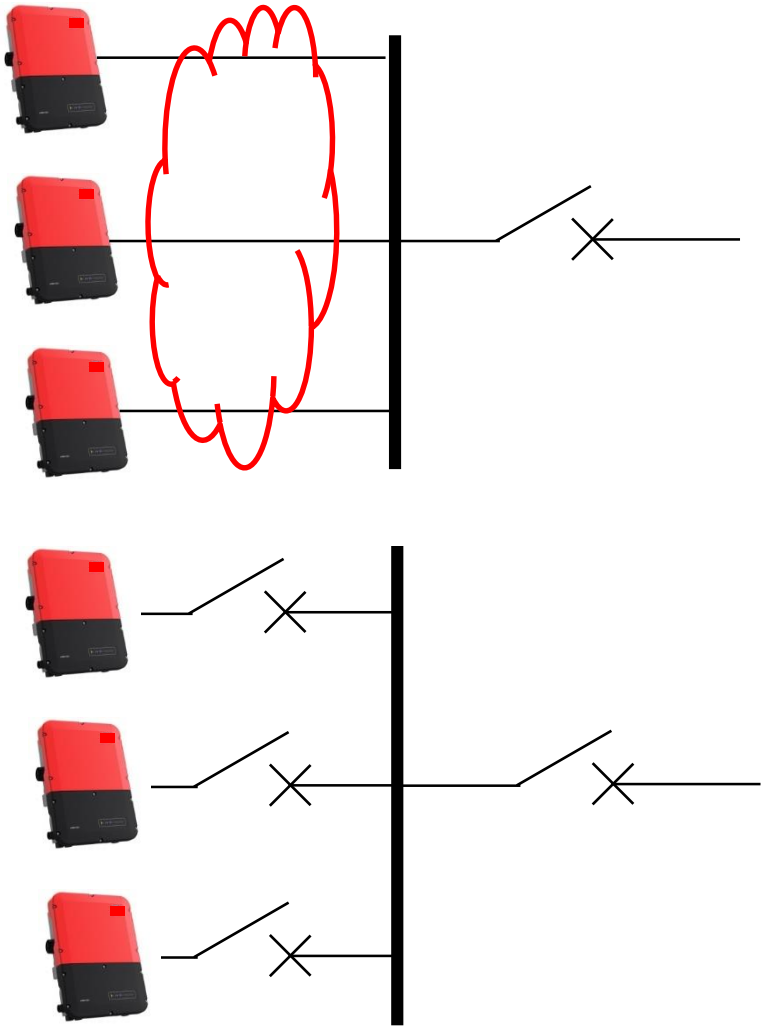
Output Voltage: 400V

> Maximum Input Voltage: 300V

< Maximum Input Voltage : **500**V

3. Common Departures

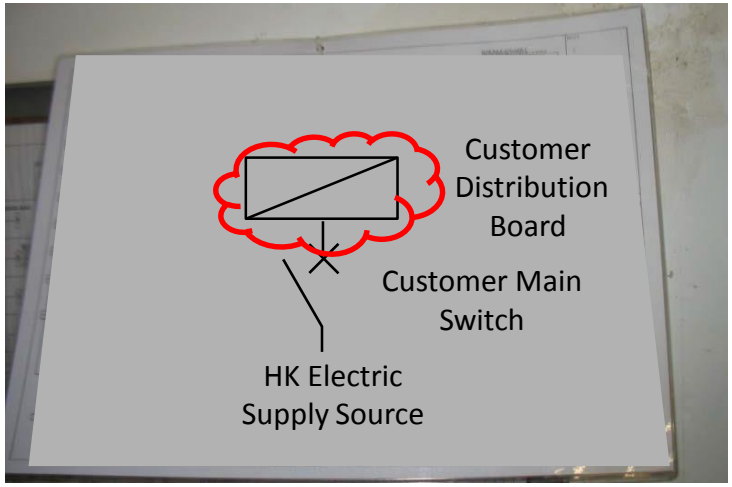
Multiple inverters with their outputs connected in parallel:-



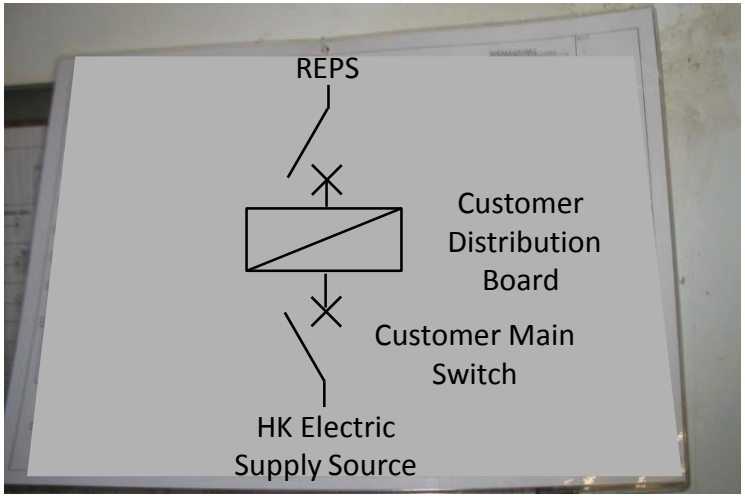
Protection devices should be provided at the outputs of each inverter that connected in parallel

3. Common Departures

Up-to-date Single-line Electrical diagrams of the REPS:-

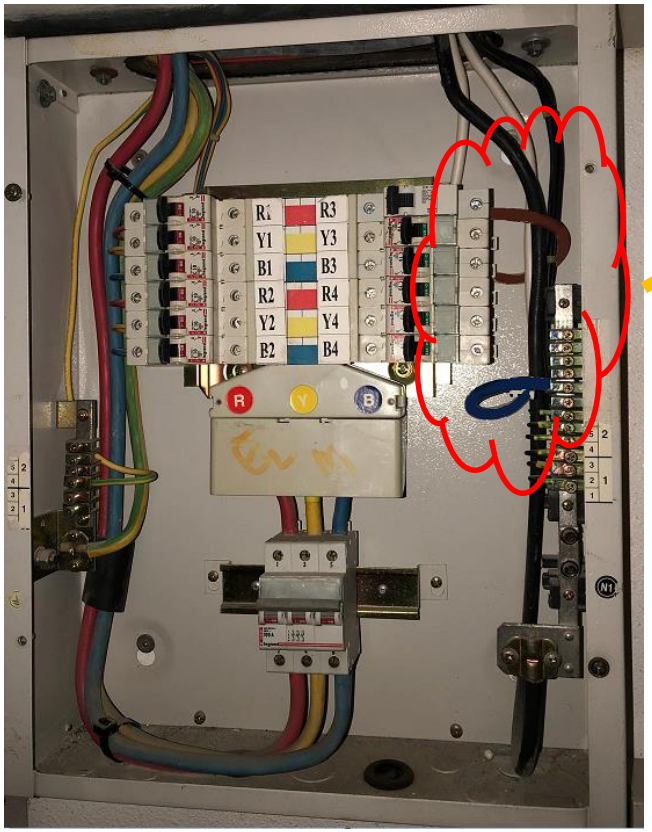


Up-to-date schematic diagram to facilitate responsible personnel to properly shut down the grid connection arrangement under normal and emergency conditions



3. Common Departures

Warning notice for :-



Enquiry/Application

Thank you