

รายละเอียดคุณลักษณะเฉพาะ

(Specification)

เลขที่ ปอ.กบญ.ฉ.2 พัสดุหลัก 2022566

## รายละเอียดคุณลักษณะเฉพาะ (Specification)

รายการ ที่	รหัสพัสดุ	รายการ	สเปคอ้างอิงเลขที่
1	1060050019	Meter(E) WATTHOUR 1P 5 (100) A O/D BLE	RMTR-038/2564



# PROVINCIAL ELECTRICITY AUTHORITY

## ELECTRICAL AND MECHANICAL ENGINEERING DIVISION

### ELECTRONIC ENERGY METERS WITH WIRELESS COMMUNICATION

Specification No.: RMTR-038/2564

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#### Invitation to Bid No.:

#### **C Material, equipment, and specifications for ELECTRONIC ENERGY METERS WITH WIRELESS COMMUNICATION**

#### **C1 General material and packing instructions**

In addition to the general instructions, the following shall be observed:

#### **1a Scope**

These specifications cover electronic energy meters with wireless communication used in PEA's system for measuring and recording electrical energy for billing, measuring, and recording other electrical quantities completed with their functions and accessories.

#### **1b Standards**

The electronic energy meters with wireless communication (hereinafter called the meters) shall be manufactured and tested in accordance with the following standards:

Thailand Industrial Standard (TIS)

TIS 1030-2552 Electricity metering equipment (a.c.) – General requirements, tests, and test conditions

TIS 2543-2555 Electricity metering equipment (a.c.) – Particular requirements – Static meters for active energy (classes 1 and 2)

International Electrotechnical Commission (IEC)

IEC 62052-11: 2003 Electricity metering equipment (a.c.) – General requirements, tests, and test conditions – Part 11: Metering equipment

IEC 62053-21: 2003 Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)

IEC 62053-23: 2003 Electricity metering equipment (a.c.) – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3)

And all other relevant standards unless otherwise specified in these specifications.

PEA will also accept the meters tested in accordance with the later edition of the above standards.

PEA will also accept the type test report in accordance with the previous edition of the above standards, if there is no significant change in any test items or no additional test item(s) compared with the above standards. On the other hand, if there is a significant change in any test items or there are any additional test items, the previous edition type test report with the additional test report(s) of the significant change test item(s) and/or additional test item(s) will be also accepted.



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#### 1c Principal requirement

##### 1c.1 Service conditions and installation

The meters shall be weatherproof and dustproof designed and constructed for **outdoor installation** on concrete poles **without additional protection** for operation under the following conditions:

- Altitude : up to 1,000 m above sea level
- Ambient air temperature : up to 55 °C
- Average relative humidity in any one year : up to 95 %
- Climatic condition : tropical climate

##### 1c.2 Ratings and characteristics

The minimum requirement of ratings and characteristics of the meters shall be according to **Table 1: Ratings and characteristics of the meters.**

**Table 1**

**Ratings and characteristics of the meters**

Ratings and characteristics	unit	Requirements <sup>1)</sup>	
		1-phase meters	3-phase 4-wire meters
Operating voltage	V AC	230 ± 10 %	230/400 ± 10 %
Current rating, direct connected, I <sub>b</sub> (I <sub>max</sub> )	A	5(100)	5(100)
Reference frequency	Hz	50	
Accuracy class			
- Active energy	-	1	1
- Reactive energy	-	-	2
Protective class	-	II	
Degree of protection	-	IP 54	
Maximum operating temperature	°C	up to 55	
Maximum limit range of operation temperature	°C	up to 70	
Rated impulse voltage withstand	kV	6	

**Note:** <sup>1)</sup> Requirements for each item of the electronic energy meters are specified in “C3 Schedule of detailed requirement”



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**1c.3 Constructional requirements**

The meters shall have constructional requirements as follows:

**1c.3.1 Mounting**

For the 1-phase meters shall be arranged for at least two-point mounting. Mounting holes shall accommodate 5.0 mm mounting screws. The upper mounting hole should be external or back of the body, and the one (1) lower mounting hole shall be on one side of the meter-base bottom part which is holding terminal block.

For the 3-phase meters shall be arranged for at least three-point mounting. Mounting holes shall accommodate 5.0 mm mounting screws. The upper mounting hole should be external or back of the body, and the two (2) lower mounting holes shall be on both sides of the meter-base bottom part which is holding terminal block, and the two (2) lower mounting holes shall be within the area of the perpendicular projection of the terminal cover.

**1c.3.2 Meter base**

Meter base shall be made of UV-resistance, high impact-resistance, and self-extinguishing polycarbonate. The color of the meter base is preferably grey.

**1c.3.3 Meter cover**

The meter cover shall be made of UV-resistance, high impact-resistance, and self-extinguishing polycarbonate. The meter cover shall be permanent seal such as using ultrasonic welding, chemical welding, lock type, etc. Sealing with glue or shear bolt shall not be accepted. The meter cover which can be opened without breaking shall not be accepted.

**1c.3.4 Terminals and terminal block**

The terminals shall be made of high-conductivity solid brass, or solid brass with nickel-plated or tin-plated. The terminal screws shall be made of solid brass or mild steel, with nickel-plated or tin-plated, or stainless steel.

The terminals and screws shall be suitable for using with aluminium and copper insulated cables having dimensions according to **Table 2: Dimensions of terminals and cables used with the meters**. Each terminal shall have two (2) fixing screws. The head of terminal screws shall be Phillips and Slot combination (Combo).

The size of terminal holes shall be according to **Table 2** and shall be the standard size from the manufacturer.

The terminals shall be designed to protect screw loosening, especially when the maximum conductor size specified in **Table 2** are installed.



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The terminals and screws shall be designed to protect a deformation of the conductors (After installation, the conductors shall be removed from the terminal blocks easily without deformation or damage of the conductors, in case change or replacing the meter). The design of the terminals and screws shall be described by the bidders.

Table 2

Dimensions of terminals and cables used with the meters

Current rating $I_b(I_{max})$ (A)	Cables			Terminals	
	Cross-section area (mm <sup>2</sup> )	Maximum Conductor diameter (mm)	Maximum diameter over insulation (mm)	Minimum diameter of holes (mm)	Bolt size
5(100)	up to 50	9.1	12.1	9.3	at least M6

1c.3.5 Terminal cover

The terminal cover shall be made of transparent (The wiring inside the cover can be observed clearly), UV-resistance, high impact-resistance, and self-extinguishing polycarbonate and suitable for cables incoming and outgoing vertically from the bottom, and shall have provision for security sealing.

The connection diagram of the meters shall be directly printed or embossed, and durably marked on the terminal cover.

The standard connection diagram is shown in Figure 1 and Figure 2 for 1-phase meters and 3-phase meters respectively.

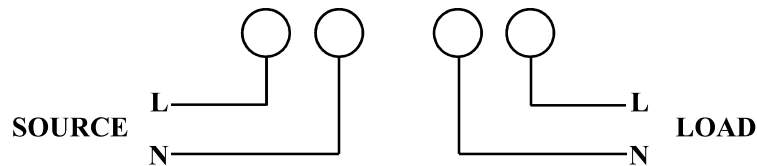


Figure 1: The standard connection diagram of 1-phase meters

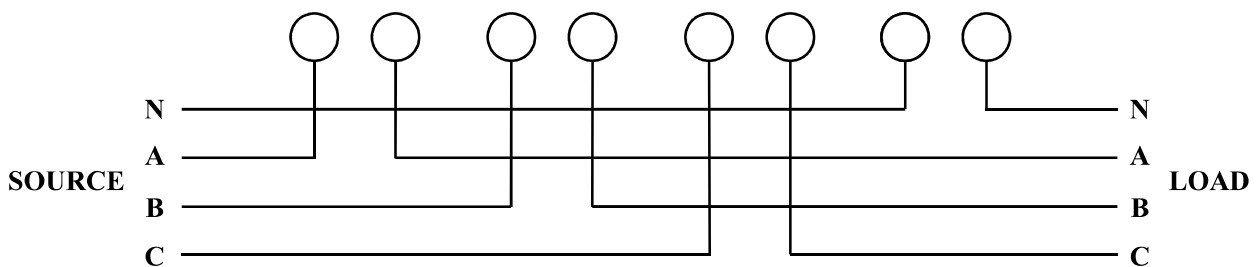


Figure 2: The standard connection diagram of 3-phase meters



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#### 1c.3.6 Nameplate

The inscription on nameplate shall be permanently marked in English according to the relevant standard, and marked with four (4) additional marks as follows:

(1) SUPPLIED BY PROVINCIAL ELECTRICITY AUTHORITY

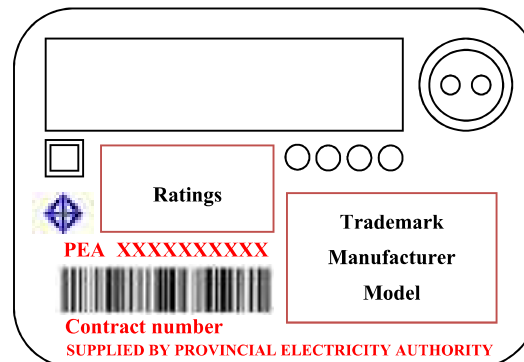
(2) PEA number : PEA XXXXXXXXXXXX

(XXXXXXXXXXXX is the number to be marked on the nameplate which shall be given by PEA after the final of bid consideration.)

(3) Barcode : The barcode to be marked shall be the same as PEA's number mentioned in Item (2). The barcode symbology shall be Code 128 according to ISO/IEC 15417)

(4) Contract number : The number to be marked on the nameplate which shall be given by PEA after the final of bid consideration.

The example of the nameplate is shown in **Figure 3**.



**Figure 3: Example of meter's nameplate**

The nameplate shall be placed inside the meter cover or placed inside a separate transparent cover for environment protection or laser marking on the meter cover.

#### 1c.3.7 Polycarbonate

The polycarbonate used for meter base, meter cover, and terminal cover shall be high impact and UV resistant grade.

Information and properties of the polycarbonate shall be given by the manufacturers.

The manufacturers have to guarantee the quality of the meter base, meter cover, and terminal cover made of polycarbonate not less than ten (10) years.

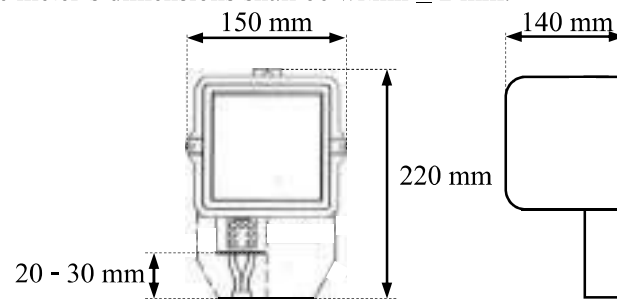
**1c.3.8 Dimensions of the 1-phase meters**

The overall dimensions of the meters shall not be more than  $150 \times 220 \times 140$  mm (width  $\times$  length  $\times$  height) as shown in **Figure 4**.

In case the length is equal to 220 mm, the distance between the lower terminal block and lower terminal cover shall be between 20 and 30 mm.

In case the length less than 220 mm, the distance between the lower terminal block and lower terminal cover shall be between 20 and 40 mm.

The tolerance of the meter's dimensions shall be within  $\pm 2$  mm.



**Figure 4: Dimensions of the 1-phase meters**

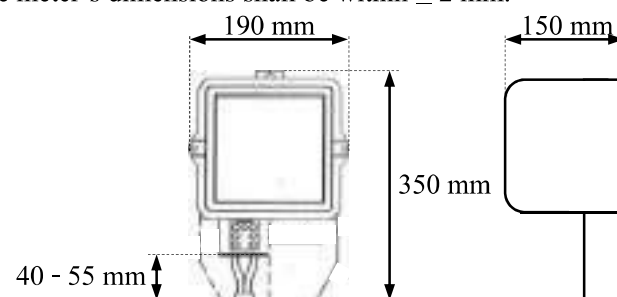
**1c.3.9 Dimensions of the 3-phase meters**

The overall dimensions of the meters shall not be more than  $190 \times 350 \times 150$  mm (width  $\times$  length  $\times$  height) as shown in **Figure 5**.

In case the length is equal to 350 mm, the distance between the lower terminal block and lower terminal cover shall be between 40 and 55 mm.

In case the length less than 350 mm, the distance between the lower terminal block and lower terminal cover shall be between 40 and 65 mm.

The tolerance of the meter's dimensions shall be within  $\pm 2$  mm.



**Figure 5: Dimensions of the 3-phase meters**





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#### 1c.4 Measured values and register unit

##### 1c.4.1 Measured values and the register unit for 1-phase meters

The minimum requirements of quantities measured and displayed by the meters shall be according to

#### Table 3: Quantities measured and displayed of the 1-phase meters.

The display shall be at least a 6-digit LCD.

**Table 3**

**Quantities measured and displayed of the 1-phase meters**

Quantities measured and displayed	Unit	Digits display <sup>2)</sup>
Display testing	-	All of the display
Current date	-	DD/MM/YY or DD.MM.YY or DD:MM:YY
Current time	-	HH:MM or HH:MM:SS
Total kWh <sup>3)</sup> (import <sup>4)</sup> , export <sup>5)</sup> , absolute <sup>6)</sup> and net <sup>7)</sup> )	kWh	XXXXXX, or better
Maximum kW demand (import and export) of the last reset	kW	XX.XXX, or better
Instantaneous active power	kW	XX.XXX, or better
Instantaneous voltage (r.m.s.)	V	XXX.X, or better
Instantaneous current (r.m.s.)	A	XXX.XX, or better
Instantaneous power factor	-	X.XX, or better

**Note:** <sup>2)</sup> The leading zero shall not be shown.

<sup>3)</sup> The group of Total kWh shown on the display shall be factory programmable and shall be also configured and programed by using the supporting software when PEA requires, to display only one (1) of three (3) groups mentioned below, PEA will give the prefer display group(s) to the Contractor after signing the contract. The groups of Total kWh are as the following:

- (1) Group 1: Total Import kWh and Total Export kWh
- (2) Group 2: Total Absolute kWh
- (3) Group 3: Total Net kWh

The values of Total kWh shall be displayed only for integer number (no rounding).

<sup>4)</sup> Import is energy delivered from the PEA's grid to the customer.

<sup>5)</sup> Export is energy received to the PEA's grid.

<sup>6)</sup> Absolute is the sum of absolute import and absolute export energy.

<sup>7)</sup> Net is the difference between the import and the export energy.

The display shall have symbols or indicators for indicating the power flow direction in four quadrants or arrow or Plus (+) or Minus (-) signs on display automatically or by pressing the actuator.



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The register unit shall be a solid-state microprocessor-based register with internal memory. The internal memory shall be a non-volatile semi-conductor type. In case of a power outage, the internal memory shall be stored data.

The minimum size of the LCD display shall be 8 cm<sup>2</sup>. The minimum height of each digit showing the measured quantities on LCD display shall be 8 mm.

The LCD display shall have the capability to operate under temperature up to 55 °C.

The register unit shall have the following display operating modes:

(1) **The default mode**, according to the following:

(1.1) **Group 1:** Total Import kWh and Total Export kWh

Display scrolling only Total Import kWh for 10 seconds, Total Export kWh for 10 seconds, and Display testing for 5 seconds.

(1.2) **Group 2:** Total Absolute kWh

Display scrolling only Total Absolute kWh for 10 seconds and Display testing for 5 seconds.

(1.3) **Group 3:** Total Net kWh

Display scrolling only Total Net kWh for 10 seconds and Display testing for 5 seconds.

The group of total kWh and the scrolling time shall be configurable by PEA.

(2) **Manual mode**, the actuator on the meter's panel shall be used for starting the display sequence and showing the various stored data according to **Table 3** and the group selected or configured by PEA. The meter's display should return to default mode if the actuator is not operated for more than 10 seconds.

In case of a power outage, the 1-phase meters shall display follow depending upon the group selected or configured by PEA on pressing the actuator:

(1) Group 1: Total Import kWh and Total Export kWh

(1.1) Total Import kWh

(1.2) Total Export kWh

(1.3) Maximum Demand Import kW (last reset)

(1.4) Maximum Demand Export kW (last reset)

(2) Group 2: Total Absolute kWh

(2.1) Total Absolute kWh

(2.2) Maximum Demand Import kW (last reset)

(2.3) Maximum Demand Export kW (last reset)

(3) Group 3: Total Net kWh

(3.1) Total Net kWh

(3.2) Maximum Demand Import kW (last reset)

(3.3) Maximum Demand Export kW (last reset)



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1c.4.2 Measured values and the register unit for 3-phase meters

The minimum requirements of quantities measured and displayed by the meters shall be according to

Table 4: Quantities measured and displayed of the 3-phase meters.

The display shall be at least a 6-digit LCD.

Table 4

Quantities measured and displayed of the 3-phase meters

Quantities measured and displayed	Unit	Digits display <sup>8)</sup>
Display testing	-	All of the display
Current date	-	DD/MM/YY or DD.MM.YY or DD:MM:YY
Current time	-	HH:MM or HH:MM:SS
Total kWh <sup>9)</sup> (import <sup>10)</sup> , export <sup>11)</sup> , absolute <sup>12)</sup> and net <sup>13)</sup> )	kWh	XXXXXX, or better
Total kvarh <sup>9)</sup> (import <sup>10)</sup> , export <sup>11)</sup> , absolute <sup>12)</sup> and net <sup>13)</sup> )	kvarh	XXXXXX, or better
Maximum kW demand (import and export) of the last reset	kW	XX.XXX, or better
Maximum kvar demand (import and export) of the last reset	kvar	XX.XXX, or better
Instantaneous total active power	kW	XX.XXX, or better
Instantaneous total reactive power	kvar	XX.XXX, or better
Instantaneous per-phase voltage (r.m.s.)	V	XXX.X, or better
Instantaneous per-phase current (r.m.s.)	A	XXX.XX, or better
Instantaneous total power factor	-	X.XX, or better

Note: <sup>8)</sup> The leading zero shall not be shown.

<sup>9)</sup> The group of Total kWh and Total kvarh shown on the display shall be factory programmable and shall be also configured and programed by using the supporting software when PEA requires, to display only one (1) of three (3) groups mentioned below, PEA will give the prefer display group(s) to the Contractor after signing the contract. The groups of Total kWh and Total kvarh are as the following

- (1) Group 1: Total Import kWh and Total Export kWh as well as Total Import kvarh and Total Export kvarh
- (2) Group 2: Total Absolute kWh and Total Absolute kvarh
- (3) Group 3: Total Net kWh and Total Net kvarh

The values of Total kWh and Total kvarh shall be displayed only for integer number (no rounding).

<sup>10)</sup> Import is energy delivered from the PEA's grid to the customer.

<sup>11)</sup> Export is energy received to the PEA's grid.

<sup>12)</sup> Absolute is the sum of absolute import and absolute export energy.

<sup>13)</sup> Net is the difference between the import and the export energy.

Each quantity in Table 4 shall be displayed with the identification code, which confirms that quantity complies with PEA's requirement. The identification code shall be specified in Table 5: Identification code of the 3-phase meters.

The identification code shall be able to change (configure) and program by using the supporting software when PEA requires.



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**Table 5**

**Identification code of the 3-phase meters**

Code	Descriptions
090	Current date
091	Current time
000	Total kWh import
009	Maximum kW demand import (last reset)
100	Total kvarh import
109	Maximum kvar demand import (last reset)
300	Total kWh export
309	Maximum kW demand export (last reset)
400	Total kvarh export
409	Maximum kvar demand export (last reset)
600	Total kWh absolute
700	Total kvarh absolute
800	Total kWh net
900	Total kvarh net
093	Instantaneous total active power
193	Instantaneous total reactive power
500	Voltage phase A
501	Voltage phase B
502	Voltage phase C
503	Current phase A
504	Current phase B
505	Current phase C
512	Power factor phase A
513	Power factor phase B
514	Power factor phase C
515	Total power factor

The display shall have symbols or indicators for indicating the power flow direction in four quadrants or arrow or Plus (+) or Minus (-) signs on display automatically or by pressing the actuator.

The register unit shall be a solid-state microprocessor-based register with internal memory. The internal memory shall be a non-volatile semi-conductor type. In case of a power outage, the internal memory shall be stored data.



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The minimum size of the LCD display shall be 10 cm<sup>2</sup>. The minimum height of each digit showing the measured quantities on LCD display shall be 8 mm.

The LCD display shall have the capability to operate under temperature up to 55 °C.

The register unit shall have the following display operating modes:

(1) **The default mode**, according to following:

(1.1) **Group 1:** Total Import kWh and Total Export kWh

Display scrolling only Total Import kWh for 10 seconds, Total Export kWh for 10 seconds, and Display testing for 5 seconds.

(1.2) **Group 2:** Total Absolute kWh

Display scrolling only Total Absolute kWh for 10 seconds and Display testing for 5 seconds.

(1.3) **Group 3:** Total Net kWh

Display scrolling only Total Net kWh for 10 seconds and Display testing for 5 seconds.

The group of total kWh and the scrolling time shall be configurable by PEA.

(2) **Manual mode**, the actuator on the meter's panel shall be used for starting the display sequence and showing the various stored data according to **Table 4** and the group selected or configured by PEA. The meter's display should return to default mode if the actuator is not operated for more than 10 seconds.

In case of a power outage, the 3-phase meters shall display follow depending upon the group selected or configured by PEA on pressing the actuator:

(1) Group 1: Total Import kWh and Total Export kWh

(1.1) Total Import kWh

(1.2) Total Export kWh

(1.3) Maximum Demand Import kW (last reset)

(1.4) Maximum Demand Export kW (last reset)

(2) Group 2: Total Absolute kWh

(2.1) Total Absolute kWh

(2.2) Maximum Demand Import kW (last reset)

(2.3) Maximum Demand Export kW (last reset)

(3) Group 3: Total Net kWh

(3.1) Total Net kWh

(3.2) Maximum Demand Import kW (last reset)

(3.3) Maximum Demand Export kW (last reset)

**1c.5 Features and functions****1c.5.1 Load profile function**

The load profile data shall be an average value measured in each 15-minute period (block demand), and the timestamp shall be done at the end of each period. In normal operation, the maximum demand which recorded in the load profile data shall be the same with the maximum demand which shown on the register unit.

The detail of load profile data shall be according to **ANNEX 1: Table 5A and Table 6A** for 1-phase and 3-phase meters respectively. The load profile status shall be according to **ANNEX 1: Table 7A**.

The load profile data shall be stored in non-volatile memory. The storage capacity of the memory shall be able to store the data of each channel for not less than 45 days.

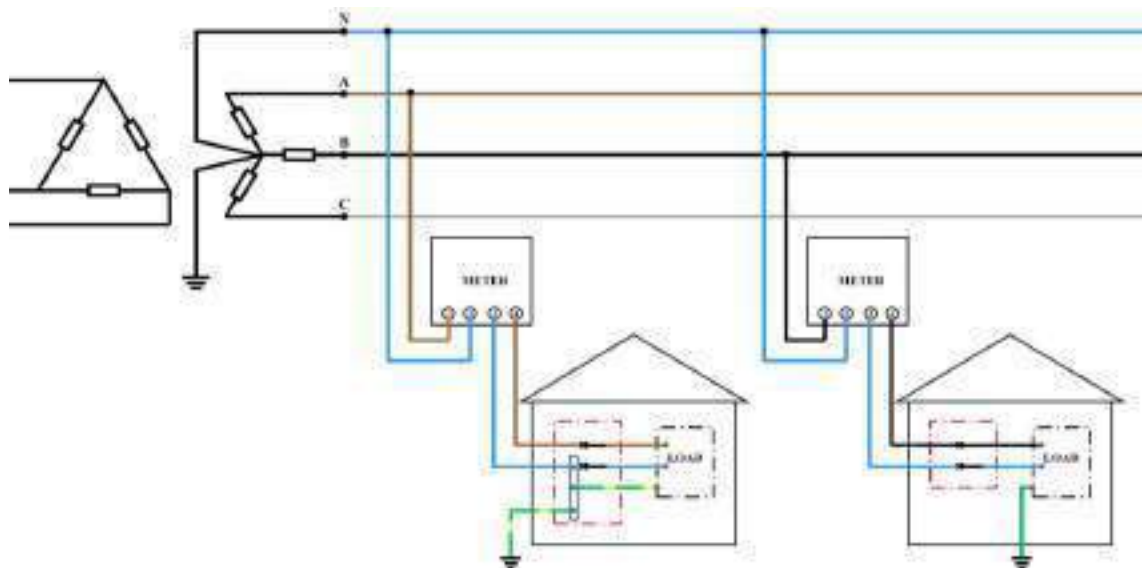
**1c.5.2 Maximum demand zero reset**

The maximum demand shall be able to be reset with PEA's mobile application and manufacturer's mobile application.

**1c.5.3 Tampering detection and alarms for 1-phase meters****1c.5.3.1 PEA's low voltage distribution system**

The 1-phase meters shall be designed to install in PEA's low voltage distribution system in **Figure 6**, the meter shall operate correctly and measure accurately.

The earthing system of PEA's low voltage distribution system can be divided in 2 types is shown in **Figure 6**.



**Figure 6: The earthing system of PEA's low voltage distribution system**

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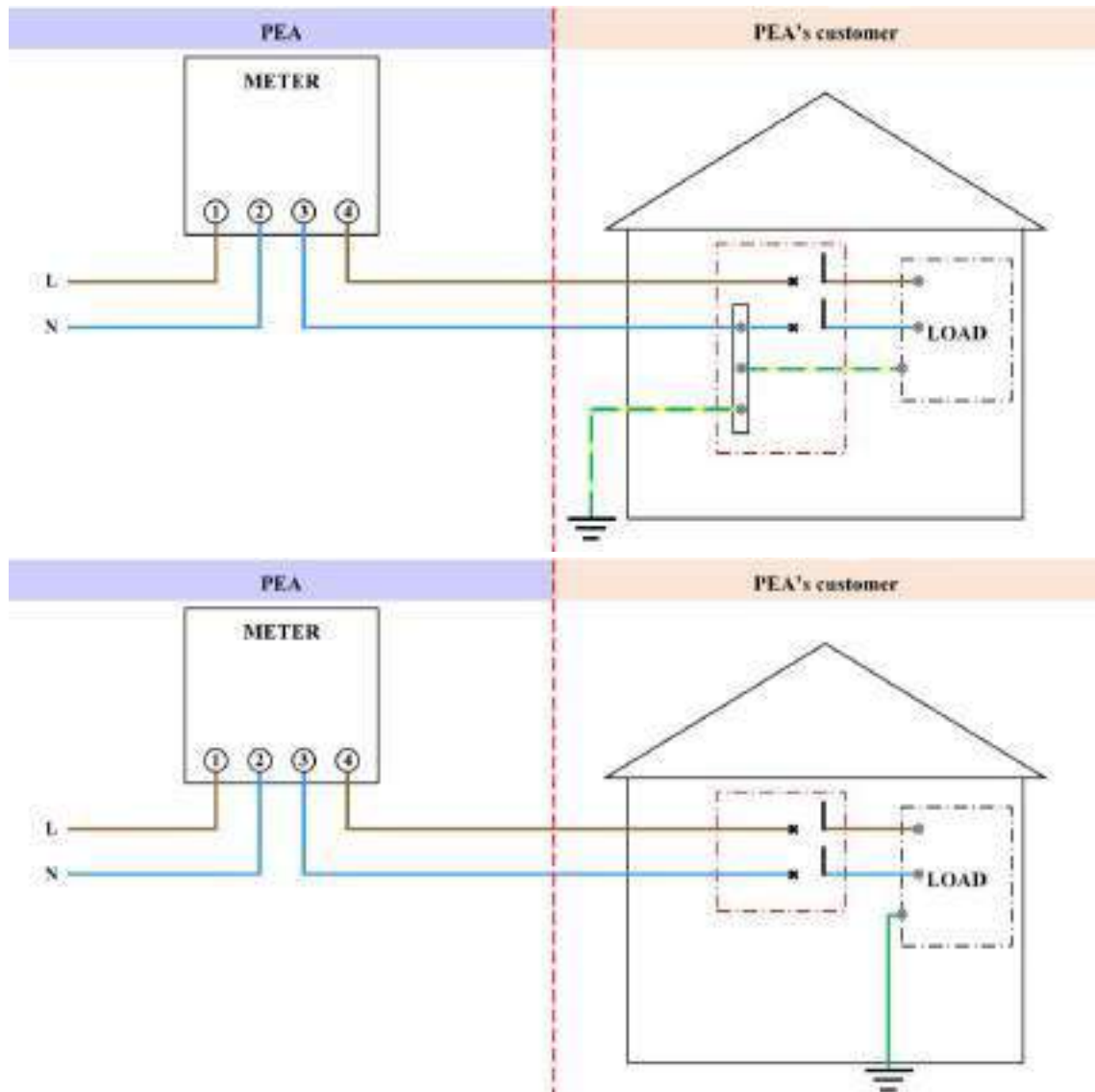
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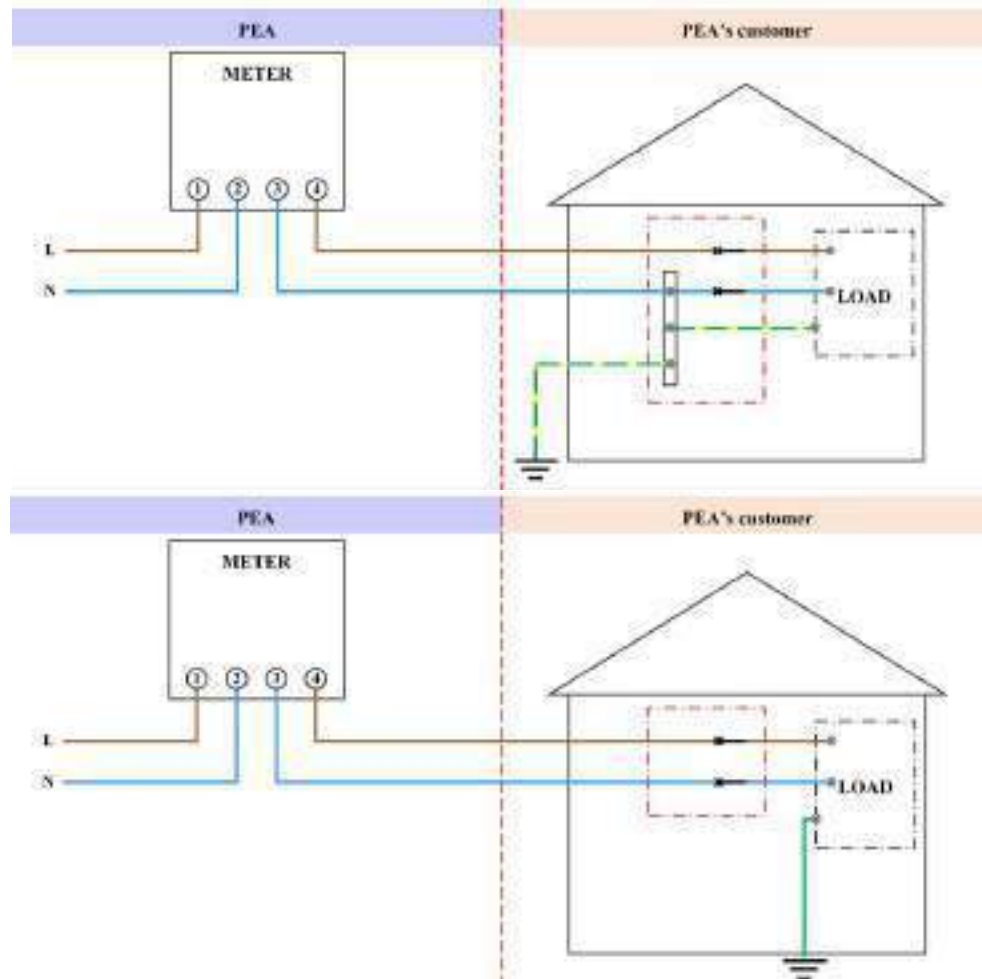
The 1-phase meters shall be operated under the following normal conditions:

- (1) In case of no energy consumption (circuit breaker is opened), the 1-phase meters shall not record energy. In this case, neutral currents may flow through the meters and earthing system. Detail as shown in **Figure 7**.



**Figure 7: In case of no energy consumption (circuit breaker is opened)**

- (2) In case the customers use electric energy (circuit breaker is closed), the 1-phase meters shall record register forward energy correctly and accurately (the meter shall record energy by using only line current. In this case, neutral currents that may flow through the meters and earthing system shall be neglected.) Detail as shown in **Figure 8**.



**Figure 8: In case the customers use electric energy (circuit breaker is closed)**

### 1c.5.3.2 Anti-tamper features

The 1-phase meters shall have at least the following anti-tamper features:

- (1) Missing neutral
- (2) Magnetic interference
- (3) Phase and neutral interchange (Phase and neutral interchange will be effective with bid invitation date from 1<sup>st</sup> January 2022)

In case tamper occurred, the 1-phase meters shall be designed the waiting time (for processing) before tamper detection. The waiting time shall be between 55 seconds and 120 seconds according to manufacturer's design.

Each anti-tamper feature shall be able to enable or disable by using the supporting software when PEA requires.



### 1c.5.3.3 Tamper conditions and anti-tamper features

The 1-phase meters shall have the tampering detection features and shall be operated under the following tamper conditions:

(1) Missing neutral

In case missing neutral is detected as shown in **Figure 9**, the Actual Current shall be recorded. The values of total kWh shall be equal to the Actual current x 230 V x 1 (unity power factor) x Time. The backup power supply shall support up to 60-day-continuous operation in this condition. In this case, the 1-phase meters shall display only Total kWh by pressing the actuator, shall be able to record an event with date and time in the non-volatile memory according to **Annex 2: Table 1B**, but the alarm signal shall not be shown.

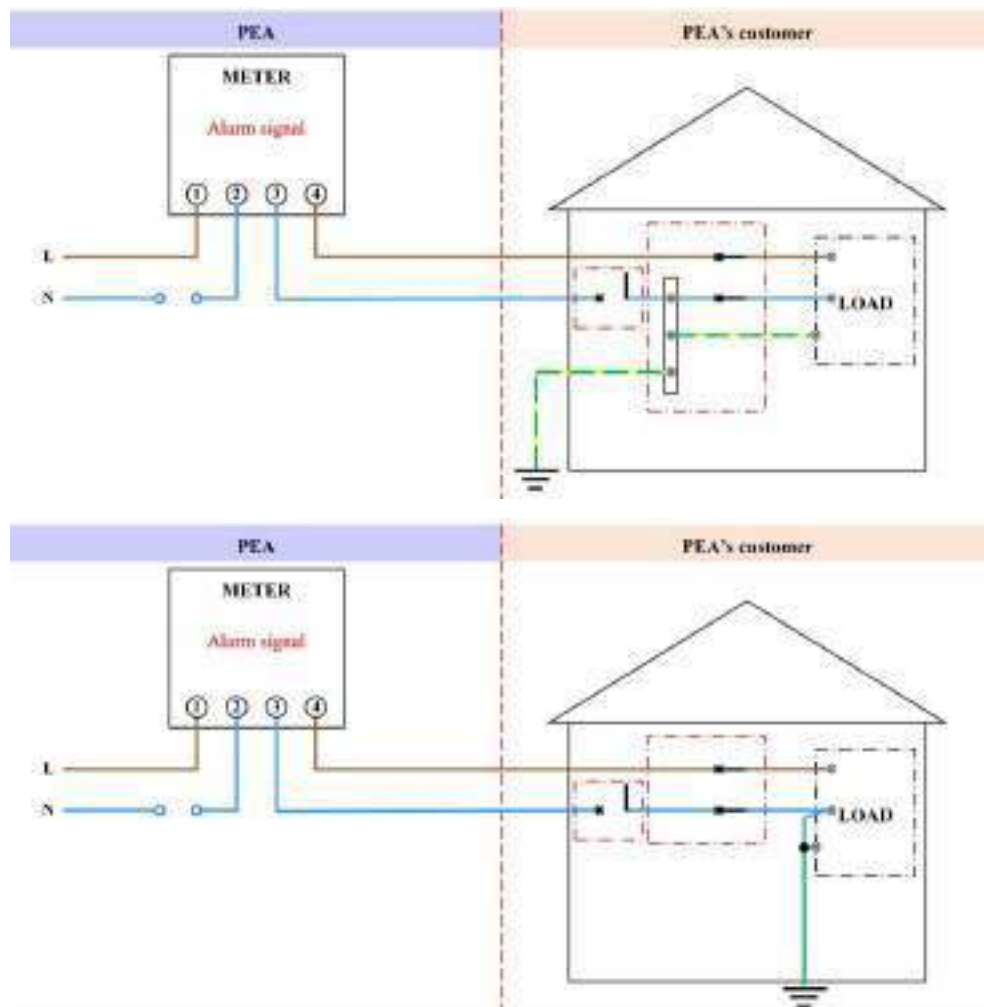


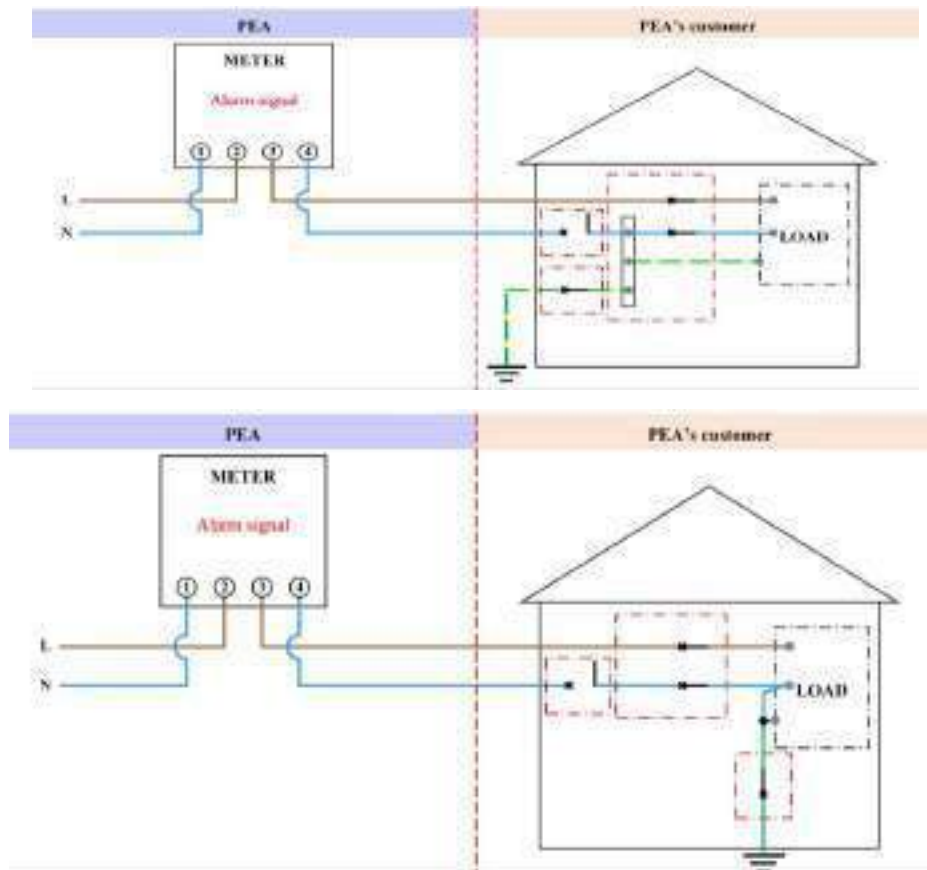
Figure 9: Missing neutral

(2) Magnetic interference

- The 1-phase meters shall be designed to protect the magnetic interfere at least  $0.15 \pm 0.05$  T from any direction. In this case, the 1-phase meters shall measure energy correctly and accurately, but the event and alarm signal shall not be recorded and shown respectively.
- Magnetic interference testing  
PEA will test by using  $0.15 \pm 0.05$  T of permanent magnet for test to prove the accuracy and the operating of meters that shall be work properly.

(3) Phase and neutral interchange (Phase and neutral interchange will be effective with bid invitation date from 1<sup>st</sup> January 2022)

- In case input phase and neutral connections are interchanged, load return is connected to local earth and it is not returned to the meters, as shown in **Figure 10**. In this case, the meter shall record the event with date and time in the non-volatile memory of the meter according to **Annex 2: Table 1B**, but it is unnecessary to measure energy correctly and accurately and the alarm signal shall not be shown.



**Figure 10: Input phase and neutral connections are interchanged, load return is connected to local earth and not returned to the meters**

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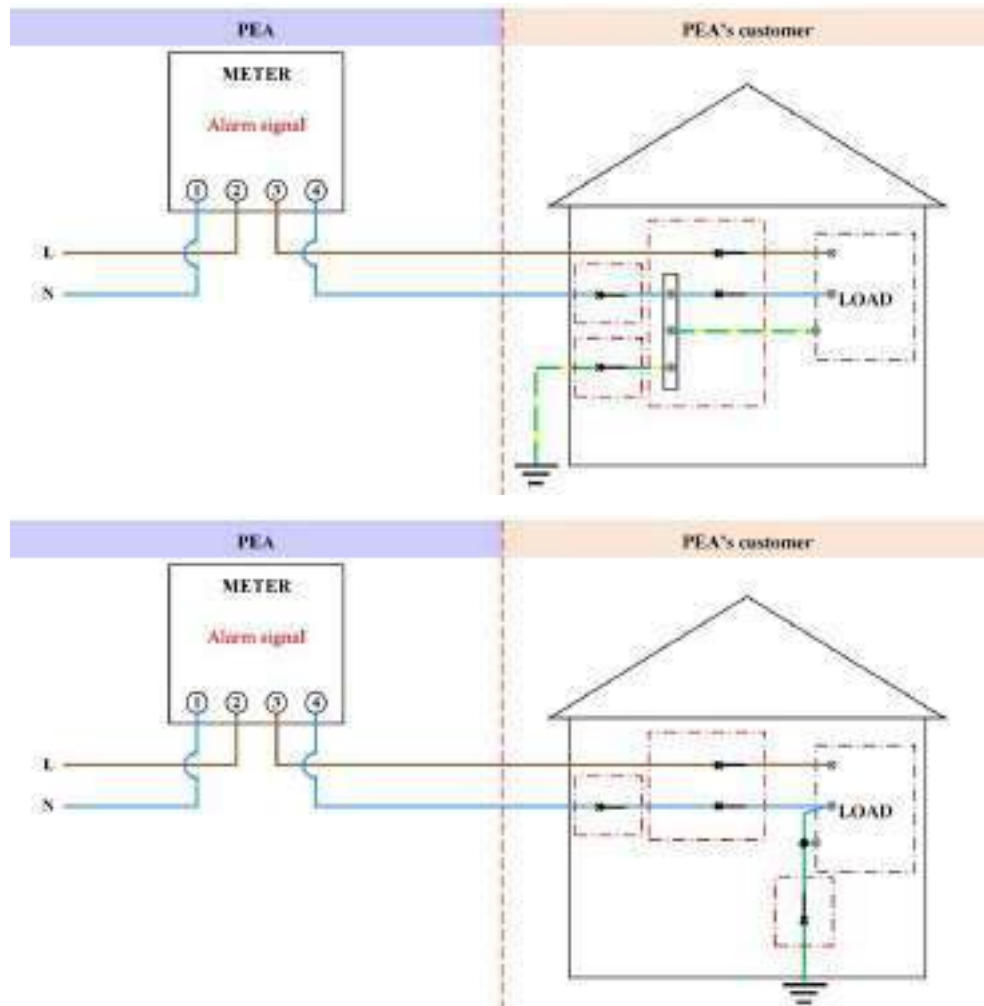
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- In case input phase and neutral connections are interchanged, load return is connected to local earth and the meters, load is returned to local earth and the meters, as shown in **Figure 11**. In this case, the meter shall record the event with date and time in the non-volatile memory of the meter according to **Annex 2: Table 1B**, but it is unnecessary to measure energy correctly and accurately and the alarm signal shall not be shown.



**Figure 11: Input phase and neutral connections are interchanged,  
load is returned to local earth and the meters**

A method for each condition of tampering detection shall be described by the bidders and shall be submitted with the bid.



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**1c.5.4 Tampering detection and alarms for 3-phase meters**

The 3-phase meters shall have the following tampering detection features and shall be able to record an event with date and time in the non-volatile memory of the meter according to **Annex 2: Table 1B** and register forward energy correctly and accurately under the following conditions:

- (1) Incoming main is connected to outgoing terminals, and load is connected to incoming terminals.

This function shall be programmable to disable by the supporting software.

- (2) In case of terminal cover is opened, the 3-phase meters shall be able to record the event but shall not be show alarm signal on the display or LED.

In the case of the 3-phase meters without “Terminal cover open detection”, the bidder shall provide other methods such as using the unopened sealed box. In this case, the bidder shall prepare the unopened sealed box for spare parts of three (3) % of the proposed meter.

- (3) The 3-phase meters shall be designed to protect the magnetic interfere at least  $0.15 \pm 0.05$  T from any direction. In this case, the 3-phase meters shall measure energy correctly and accurately, but the event and alarm signal shall not be recorded and shown respectively. For magnetic interference testing, PEA will test by using  $0.15 \pm 0.05$  T of permanent magnet for test to prove the accuracy and the operating of meters that shall be work properly.

- (4) Other tampering events according to the manufacturer's design.

A method for each condition of tampering detection shall be described by the bidders and shall be submitted with the bid.

In case tamper occurred, the 3-phase meters shall be designed the waiting time (for processing) before tamper detection. The waiting time shall be between 55 seconds and 120 seconds according to manufacturer’s design.

Each anti-tamper feature shall be able to enable or disable by using the supporting software when PEA requires.

**1c.5.5 Over and under voltage detection**

The meters shall detect an over voltage (more than  $230\text{ V} + 10\%$ ) and under voltage (less than  $230\text{ V} - 10\%$ ) of the system when it occurred over 60 seconds continuously and shall record as an over voltage and under voltage events respectively. After the over voltage and under voltage events recorded if the system voltage is recovered to normal voltage ( $230\text{ V} \pm 10\%$ ), over 60 seconds continuously, the meters shall record as a normal voltage event. All events can be downloaded by using local and wireless communication.

**1c.5.6 Current neutral sensor (Current neutral sensor will be effective with bid invitation date from 1<sup>st</sup> January 2022)**

The 1-phase meters shall be completed with the current sensor on the neutral terminal to measure the neutral current in normal condition and tamper conditions according to item (3) Phase and neutral interchange, in **1c.5.3.3 Tamper conditions and anti-tamper features**.



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**1c.6 Communications**

**1c.6.1 Local communication**

The meters shall have an optical port for data retrieval and configuration of all parameters of the meters. The physical of the port shall be according to IEC 62056-21.

**1c.6.2 Wireless communication**

The meters shall have Bluetooth technology for communication between the meters and android mobile devices for reading the data. The version of Bluetooth technology shall be 4.2, or later version.

The communication profile of the meters shall be according to **ANNEX 1**.

The details of the PEA's mobile application are specified in the "**ADDENDUM 3: Bluetooth Meter Application Interface – Spot Billing Application**" attached.

The details of the test procedure of meters and PEA's mobile application are specified in the "**ADDENDUM 4: Test procedure of the compatibility of meters and Bluetooth Meter Application Interface – Spot Billing Application**" attached.

**1c.7 Functional self-checking**

The meters shall be able to check its functional failures and display them on the meter's panel. The functional failures shall be checked by itself are as follows:

- (1) Internal failures such as clock fail, memory fails, etc.
- (2) Low battery (if the battery is used)
- (3) Other functional checking according to the manufacturer's design.

**1c.8 Real-time clock and calendar**

The meters shall have an internal real-time clock and/or a crystal-controlled time clock for providing calendar functions (such as the time of day, date, year, etc.). The accuracy of the clock shall be  $\pm 2.0$  seconds per day, or better.

**1c.9 Power supply**

The meters shall consume power from the main-line power supply. For 3-phase meters, meters shall operate if any two (2) among three (3)-phase and neutral are available e.g., the meter shall operate if AN, BN, CN, AB, BC, or AC is available.



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**1c.10 Backup power supply**

The backup power supply shall be provided for keeping time in case of a power outage. The backup power supply shall be the battery and/or super capacitor. The backup power supply or other equipment shall have a minimum operating life span of ten (10) years in normal condition (without tampering cases) and storage life span (without line power) of at least two (2) years. Fixed type (On board) and/or replaceable type batteries meeting above condition shall be accepted. If the replaceable type batteries are proposed, the batteries shall be commercially standard type.

**1c.11 Pulse output**

The 1-phase meters shall have LED pulse output for testing of active energy accuracy (fix impulse/kWh).

The 3-phase meters shall have LED pulse outputs for testing of active energy accuracy (fix impulse/kWh) and reactive energy accuracy (fix impulse/kvarh), two (2) separated outputs shall be provided.

**1c.12 Security system**

The meters shall have a sophisticated security system to prevent fraudulent interference such as changing the meters reading via local communication.

The security compliance shall be in accordance with DLMS architecture.

The meters shall have at least two (2) groups of the accessible password as follows:

(1) Group 1: Password for administrators to write the software, set the system of the meters such as set function, set time, set password security for each group, and reset the register value.

The value of Total kWh cannot be changed.

(2) Group 2: Password for readers to read the stored data, including to read the time of the meters

**1c.13 Supporting software**

The supporting software shall have at least the following features and functions:

- Graphical User Interface (GUI) based
- Manual data retrieval
- Display all measured quantities
- Uploading firmware<sup>14)</sup>
- User authenticity on access levels
- Supporting meter calibration<sup>14)</sup>
- Clearing meter data<sup>14)</sup>
- Configurable of all parameters and programmable, according to the following items:
  - (1) Groups of Total kWh (only for 1-phase meters)
  - (2) Groups of Total kWh and Total kvarh (only for 3-phase meters)
  - (3) Scrolling time for default mode of display
  - (4) Identification code (only for 3-phase meters)
  - (5) Anti-tamper features



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- Writing all parameters completely at once
- Operating on Microsoft Windows 7, or later version

**Note:** <sup>14)</sup> PEA will also accept the proposed supporting software without uploading firmware and/or supporting meter calibration functions and/or clearing meter data, but in this case it's responsibility of the contractor and the meter's manufacturer to upload firmware and/or calibrate the meters and/or clearing meter data when the meters have a malfunction or PEA request, for the whole lifetime of the meters (ten (10) years commencing from the date of the meters are accepted by PEA). The contractor and/or the meter's manufacturer shall take responsibility within thirty (30) calendar days counted from the date of receiving notice for PEA.

**1c.14 Calculation of the Mean Time to Failure**

The documents such as calculation sheets, test reports, etc. showing the Mean Time to Failure (MTTF) of the proposed meters is equal to or more than ten (10) years shall be submitted with the bid.

**1c.15 Samples**

The bidders have to supply three (3) samples of the proposed meters with necessary accessories for testing such as notebook, optical probe, supporting software, etc. to PEA within five (5) working days counted from the bid closing date. The sample shall be the identical of the proposed meter.

The bidders who cannot supply the samples shall be rejected.

PEA reserves the right to test/check the samples according to the test items specified in **Table 6 : Sample test/check items**. In the case of the failing test/check results or the defective or inoperative meters during the test, the bidders shall be rejected.

PEA will also accept the major test report or major test certificate from PEA's Meter Division (from PEA's head office) instead of submitting the sample for Major test/check items. However, the bidders have to supply three (3) samples according to the above condition.

The major test report or major test certificate shall be made on the same product, type/model, physical properties, and all ratings as the proposed meter for this bid.

The major test report or major test certificate can be submitted with the bid.

The bidders who have submitted the major test report or major test certificate which is different from the above condition will be rejected.

The samples and necessary accessories will be returned after bid consideration. For the bidder who wins the bid, the sample of the proposed meters shall not be returned but necessary accessories will be returned after bid consideration.



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Table 6

Sample test/check items

Major test/check items
<ol style="list-style-type: none"> <li>1. Type test items according to reference standards such as tests of accuracy requirements, tests of insulation properties</li> <li>2. Physical properties checking, consisting of:               <ol style="list-style-type: none"> <li>2.1 Meter cover (see <b>1c.3.3</b>)</li> <li>2.2 Terminals and terminal block (see <b>1c.3.4</b>)</li> <li>2.3 Terminal cover (see <b>1c.3.5</b>) only for physical properties do not include connection diagram</li> <li>2.4 Dimensions of the 1-phase meters (see <b>1c.3.8</b>)</li> <li>2.5 Dimensions of the 3-phase meters (see <b>1c.3.9</b>)</li> <li>2.6 LED for showing pulse output (see <b>1c.11</b>) (hardware)</li> </ol> </li> <li>3. Measured values and register unit, consisting of:               <ol style="list-style-type: none"> <li>3.1 Measured values and the register unit for 1-phase meters (see <b>1c.4.1</b>)</li> <li>3.2 Measured values and the register unit for 3-phase meters (see <b>1c.4.2</b>)</li> </ol> </li> <li>4. Function test, consisting of:               <ol style="list-style-type: none"> <li>4.1 Tampering detection and alarms for 1-phase meters (see <b>1c.5.3</b>)</li> <li>4.2 Tampering detection and alarms for 3-phase meters (see <b>1c.5.4</b>)</li> <li>4.3 Power supply (see <b>1c.9</b>)</li> </ol> </li> <li>5. Communications (see <b>1c.6</b>)</li> <li>6. Pulse output (see <b>1c.11</b>) (software)</li> </ol>
Other tests/check items
<ol style="list-style-type: none"> <li>1. Physical properties checking, consisting of:               <ol style="list-style-type: none"> <li>1.1 Mounting (see <b>1c.3.1</b>)</li> <li>1.2 Terminals screws (see <b>1c.3.4</b>)</li> <li>1.3 Connection diagram (see <b>1c.3.5</b>)</li> <li>1.4 Nameplate (see <b>1c.3.6</b>)</li> </ol> </li> <li>2. Function test, consisting of:               <ol style="list-style-type: none"> <li>2.1 Load profile function (see <b>1c.5.1</b>)</li> <li>2.2 Maximum demand zero reset (see <b>1c.5.2</b>)</li> <li>2.3 Over and under voltage detection (see <b>1c.5.5</b>)</li> <li>2.4 Functional self-checking (see <b>1c.7</b>)</li> <li>2.5 Security system (see <b>1c.12</b>)</li> </ol> </li> <li>3. Supporting software (see <b>1c.13</b>)</li> </ol>

**Note:**

1. The major test/check items mean the samples shall be completely passed the test/check without any correction.
2. For the other tests/check items, if the samples failed the tests/checks, PEA will give notice for correction to the bidders. The bidder who wins the bid shall be correct the meters according to the notice before delivery.





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#### 1d Packing

Each meter and accessory shall be packed in a suitable corrugate-paper package with cushioning materials such as air bubble or other methods in one (1) set per package to avoid damage during transportation.

The following minimum information shall be marked on the package:

- (1) Manufacturer's name or Trade mark
- (2) Type/model
- (3) Current rating
- (4) PEA's number
- (5) Contract number

The meters of the same item shall be packed in a suitable wooden case in units of one hundred (100) or one hundred and twenty (120) for 1-phase meters and ten (10) or fifty (50) for 3-phase meters.

The wooden case shall be designed to be movable by a forklift truck in such a manner that the truck's forks can be inserted at any side of the bottom of the case.

If the wooden case is made of rubberwood (Yang-para or Hevea brasiliensis), the wooden parts shall be treated with wood preservative.

Plastic foam shall not be accepted.

#### 1e Tests and test reports

##### 1e.1 Routine test

Each meter shall pass the manufacturer's standard routine tests, and also pass the following tests in accordance with the relevant standards:

- (1) AC voltage tests
- (2) Limits of error due to variation of the current
  - (2.1)  $0.05 I_b$ , p.f. 1.0, balanced phase
  - (2.2)  $0.1 I_b$ , p.f. 1.0, balanced phase
  - (2.3)  $0.2 I_b$ , p.f. 0.5L (inductive load), balanced phase
  - (2.4)  $0.2 I_b$ , p.f. 0.8C (capacitive load), balanced phase
  - (2.5)  $I_b$ , p.f. 1.0, balanced phase
  - (2.6)  $I_b$ , p.f. 0.5L (inductive load), balanced phase
  - (2.7)  $I_b$ , p.f. 0.8C (capacitive load), balanced phase
  - (2.8)  $I_b$ , p.f. 1.0, unbalanced phase (only for 3-phase meters)
  - (2.9)  $I_{max}$ , p.f. 1.0, balanced phase
  - (2.10)  $I_{max}$ , p.f. 0.5L (inductive load), balanced phase
  - (2.11)  $I_{max}$ , p.f. 0.8C (capacitive load), balanced phase



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- (3) Interpretation of test results (In case test results fall outside the limits in 2)
- (4) Test of meter constant
- (5) Initial start-up of the meter
- (6) Test of starting condition
- (7) Test of no-load condition

The list of the routine test shall be submitted with the bid.

**1e.2 Type test**

Meter shall pass the following type tests in accordance with the TIS 1030 and TIS 2543 standards (or IEC 62052-11 and IEC 62053-21 standards):

- (1) Tests of insulation properties
  - (1.1) Impulse voltage tests
  - (1.2) AC voltage tests
- (2) Tests of accuracy requirements
  - (2.1) Limits of error due to variation of the current
  - (2.2) Interpretation of test results (In case test results fall outside the limits in 2.1)
  - (2.3) Test of meter constant
  - (2.4) Initial start-up of the meter
  - (2.5) Test of starting condition
  - (2.6) Test of no-load condition
  - (2.7) Test of influence quantities
- (3) Tests of electrical requirements
  - (3.1) Test of power consumption
  - (3.2) Test of influence of supply voltage
  - (3.3) Test of influence of short-time overcurrents
  - (3.4) Test of influence of self-heating
  - (3.5) Test of influence of heating
- (4) Tests for electromagnetic compatibility (EMC)
  - (4.1) Radio interference suppression
  - (4.2) Fast transient burst test
  - (4.3) Damped oscillatory waves immunity test (only for CT operated meters)
  - (4.4) Test of immunity to electromagnetic RF fields
  - (4.5) Test of immunity to conducted disturbances, induced by radio-frequency fields
  - (4.6) Test of immunity to electrostatic discharges
  - (4.7) Surge immunity test



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- (5) Tests of the effect of the climatic environments
  - (5.1) Dry heat test
  - (5.2) Cold test
  - (5.3) Damp heat, cyclic test
  - (5.4) Solar radiation test
- (6) Mechanical tests
  - (6.1) Vibration test
  - (6.2) Shock test
  - (6.3) Spring hammer test
  - (6.4) Tests of protection against penetration of dust and water
  - (6.5) Test of resistance to heat and fire

The type tests shall be conducted or inspected by the acknowledged testing laboratories/institutes as following:

- (1) Independent laboratories/institutes which are members of the Short-circuit Testing Liaison (STL) or independent laboratories/institutes which are accredited according to TIS 17025 or ISO/IEC 17025 with the scope of accreditation covered the relevant test items, standards, and equipment. The certification and scope of accreditation of the independent laboratories/institutes shall be submitted with the bid for consideration.
- (2) Thailand's national laboratories, institutes, universities, and electric utilities, as follows:
  - National Metal and Materials Technology Center (MTEC)
  - Electrical and Electronic Products Testing Center (PTEC)
  - Thai Industrial Standards Institute (TISI)
  - Electrical and Electronics Institute (EEI)
  - Department of Science Service (DSS)
  - Testing Laboratory, Electrical Engineering Department, Faculty of Engineering, Chulalongkorn University
  - Electricity Generating Authority of Thailand (EGAT)
  - Metropolitan Electricity Authority (MEA)
  - Provincial Electricity Authority (PEA)
  - Other laboratories, institutes, universities or electric utilities approved by PEA

In case of the foreign manufacturers having experience of more than twenty (20) years in design, manufacture and sell the meters, PEA will accept type test report(s) conducted by the manufacturer's laboratory or other independent laboratories without qualification mentioned in (1) or (2). Documents showing the manufacturer's experience such as the reference list shall be submitted with the bid for consideration.



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The bidders or manufacturers who prefer to carry out the type tests of the meters with the laboratories or by the manufacturers themselves without the qualification mentioned above, the detail of the test facilities of the laboratories or the manufacturer shall be submitted to PEA for approval before proceeding the tests and before the bid closing date. PEA reserves the right to send representatives to inspect and witness the tests with the cost of the bidders or manufacturers.

The type test report done by the laboratories in Thailand or local manufacturers shall be valid within five (5) years counted from the issued date in the test report to the bid closing date.

The type test reports shall be made on the same product, type/model, physical properties, and all ratings of the meter(s) which PEA want to purchase.

The type test reports shall be submitted with the bid.

PEA will also accept other documents instead of the type test reports and type test certificates in the following conditions:

- (1) In case the proposed meters has been supplied to PEA and get the order from PEA's Procurement Department (from PEA's head office), the Purchase Order (PO) can be submitted, or
- (2) In case the proposed meters has been registered for PEA Product Acceptance, the not-expired registration certificate counted to the bid closing date can be submitted, or
- (3) In case the proposed meters has been registered for Product lists for substation turnkey project, the not-expired registration certificate counted to the bid closing date can be submitted instead

However, the document in case (1) and (2) shall be proved that the meters specified in the PO or registration certificate shall be the same product, type/model and all ratings as the proposed meters for this bid and shall be used the same PEA's specification number. In case (3), the meters specified in the registration certificate shall be the same product, type/model, and all ratings as the proposed meters for this bid.

**The cost of all tests and reports shall be borne by the manufacturers or bidders.**

#### **1e.3 Acceptance tests**

PEA's acceptance committee will inspect and randomly sampling the meters for testing. The details of the acceptance test are specified in the "Addendum 1" attached.

PEA reserves the right to test the samples by PEA's laboratory or independent laboratory or the manufacturer's laboratory.

**The cost of all tests and reports shall be borne by the contractor.**



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**1f Other critical documents**

The other critical documents of the proposed electronic energy meters and accessories shall be submitted with the bid as follows:

- (1) Catalogue, rating, and characteristics of the electronic energy meters, communication modules, and accessories
- (2) Details and drawings, with dimensions in mm, of the electronic energy meters, communication modules and accessories
- (3) Description of the supplied communication and supporting software



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**C2 Material and packing data of the electronic energy meters**

The following guarantee performances and details shall be submitted with the bid:

**2a Critical documents of the proposed electronic energy meters with wireless communication and accessories (See pages 30 of 30).**

**2b Packing details**

Packing method (shown by drawing(s), and describe packing materials, the wooden case only)

Dimensions of each package in cm

Gross weight of each package in kg

Net weight of each package in kg

Number of packages in each wooden case

Volume of each wooden case in m<sup>3</sup>

Gross weight of each wooden case in kg

Number of wooden cases

Type of storage facility required (indoor, outdoor)



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**Note: Conditions for documentation and consideration**

1. The Contractor has to supply the following documents, before shipment/delivery, for each type of the ordered meters and accessories.
  - 1.1 Reports of type tests and routine tests (in English and/or Thai)
  - 1.2 Twelve (12) copies of the complete installation, operation, and maintenance instructions (in English and Thai)
  - 1.3 Twelve (12) copies of complete part lists (in English and/or Thai)
  - 1.4 Six (6) copies of instruction of the communication protocol and security system (in English and Thai)
  - 1.5 Six (6) copies of software handbooks for users and programmers (in English and Thai)

The above documents shall be sent to the following address:

**Meter and Transformer System Department**

Provincial Electricity Authority  
200 Ngam Wong Wan Road, Chatuchak  
Bangkok Metropolis Thailand  
10900

2. Delivery time is also one of the important factors to be considered.
3. Partial shipment/delivery is allowed.
4. The Contractor shall send the firmware or operation program which suitable for PEA's requirement such as PEA's electricity tariff, etc. to **Meter and Transformer System Department** within eight (8) working days counted from the date of signing the contract.  
PEA will check firmware or operation program within six (6) working days counted from the date of receiving firmware or operation program.



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#### Critical documents of the proposed electronic energy meters with wireless communication and accessories

Item	Required technical documents	Proposed technical document	Reference document (page/folder)
1	Description of method for each condition of tampering detection, as mentioned in <b>1c.5.3</b> and <b>1c.5.4</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2	Documents such as calculation sheets, test reports, etc. showing the Mean Time to Failure (MTTF) of the proposed electronic energy meters is equal to or more than ten (10) years, as mentioned in <b>1c.14</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3	Major test report or major test certificate (In case of the bidder submit the major test report or major test certificate instead of submitting the sample for Major test/check items of <b>1c.15</b> )	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4	List of routine tests, as mentioned in <b>1e.1</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5	Type/design test reports with detail of testing laboratories/institutes, or	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	The copy of previous Purchase Order (PO) or Contract with List of suppliers or Proposal form, or	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	PEA Product Acceptance registration certificate, or	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	Product lists registration certificate	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6	Documents for showing the manufacturer's experience. (In case of the test by the manufacturer's laboratory or other independent laboratories without qualification mentioned in (1) or (2) of <b>1e.2 Type test</b> )	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7	Catalogue, rating, and characteristics of the electronic energy meters, communication modules, and accessories, as mentioned in <b>1f</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8	Details and drawings, with dimensions in mm, of the electronic energy meters, communication modules and accessories, as mentioned in <b>1f</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9	Description of the supplied communication and supporting software, as mentioned in <b>1f</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10	Packing details, as mentioned in <b>2b</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	

**Note:** The bidders who do not submit all critical documents mentioned in the above table with the bid will be rejected.





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### C3 Schedule of detailed requirement

#### Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
1	1060050019	1 lot	<p><del>1547</del></p> <p>1.1 .....set(s) Electronic energy meter, 1-phase 2-wire, direct connected, with:            Operating voltage : 230 ± 10 % V AC            Current rating, <math>I_b(I_{max})</math> : 5(100) A            Complete with:            1) Supporting software            2) Instruction manuals for meter and software in Thai and English            3) And other according to manufacturer's design (give details)</p> <p>1.2 .....<sup>2</sup>set(s) Optical probe for meter communication</p>
2	1060050111	1 lot	<p>2.1 .....set(s) Electronic energy meter, 3-phase 4-wire, direct connected, with:            Operating voltage : 230/400 ± 10 % V AC            Current rating, <math>I_b(I_{max})</math> : 5(100) A            Complete with:            1) Supporting software            2) Instruction manuals for meter and software in Thai and English            3) And other according to manufacturer's design (give details)</p> <p>2.2 .....set(s) Optical probe for meter communication</p> <p><b>Note:</b></p> <ol style="list-style-type: none"> <li>The bidders have to quote the unit costs.</li> <li>Training course conducted by a specialist from the manufacturer shall be provided by the contractor, for PEA's personnel, not less than two (2) days, for installation, operation, configuration, and maintenance of the meters including the software. <b>The training course shall be free of charge.</b></li> <li>The contractor has to guarantee the quality of the meters for <b>five (5) years</b> commencing from the date PEA receives the meters and accessories at the final delivery lot. During the guarantee period, the contractor shall replace the defective or inoperative meters, caused by the quality of the meters according to PEA's regulation, by the new one with free of charge, within thirty (30) calendar days counted from the date of receiving notice from PEA, and shall also pay a penalty of One thousand and five hundred (1,500) THB for each defective or inoperative meter.</li> </ol>

Invitation to Bid No : ปอ.กบญ.ฉ.2 พัสดุหลัก 2022566

Specification No :

C3 Schedule of detailed requirement

Item	PEA material No	Quantity	Description
	1060050019	15,478	เป็นพัสดุที่ผลิตในประเทศไทย



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**C4 Price schedule**

Invitation to Bid No.:

		<b>Manufacturer :</b> <b>Country of origin :</b> <b>Trade-mark :</b>				
Item	PEA Material No.	Catalogue No.	Description	Quantity	Unit Cost (See details & conditions attached)	Total Cost (See details & conditions attached)
1	1060050019		1.1 Electronic energy meter, 1-phase 2-wire, direct connected, with: Operating voltage : 230 ± 10 % V AC Current rating, $I_b(I_{max})$ : 5(100) A Complete with: 1) Supporting software 2) Instruction manuals for meter and software in Thai and English 3) And other according to manufacturer's design (give details)  1.2 Optical probe for meter communication	set(s)		
					Total of Item 1	



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**C4 Price schedule**

Invitation to Bid No.:

		<b>Manufacturer :</b> <b>Country of origin :</b> <b>Trade-mark :</b>				
Item	PEA Material No.	Catalogue No.	Description	Quantity	Unit Cost (See details & conditions attached)	Total Cost (See details & conditions attached)
2	1060050111		2.1 Electronic energy meter, 3-phase 4-wire, direct connected, with: Operating voltage : 230/400 ± 10 % V AC Current rating, $I_b(I_{max})$ : 5(100) A Complete with: 1) Supporting software 2) Instruction manuals for meter and software in Thai and English 3) And other according to manufacturer's design (give details)  2.2 Optical probe for meter communication	set(s)		
					Total of Item 2	



ANNEX 1

DLMS/COSEM OBIS code for electronic energy meters with wireless communication

1. DLMS/COSEM Communication Profile

The communication profile for the meters with Bluetooth technology is HDLC profile. The detail of HDLC is show in the Figure 1A.

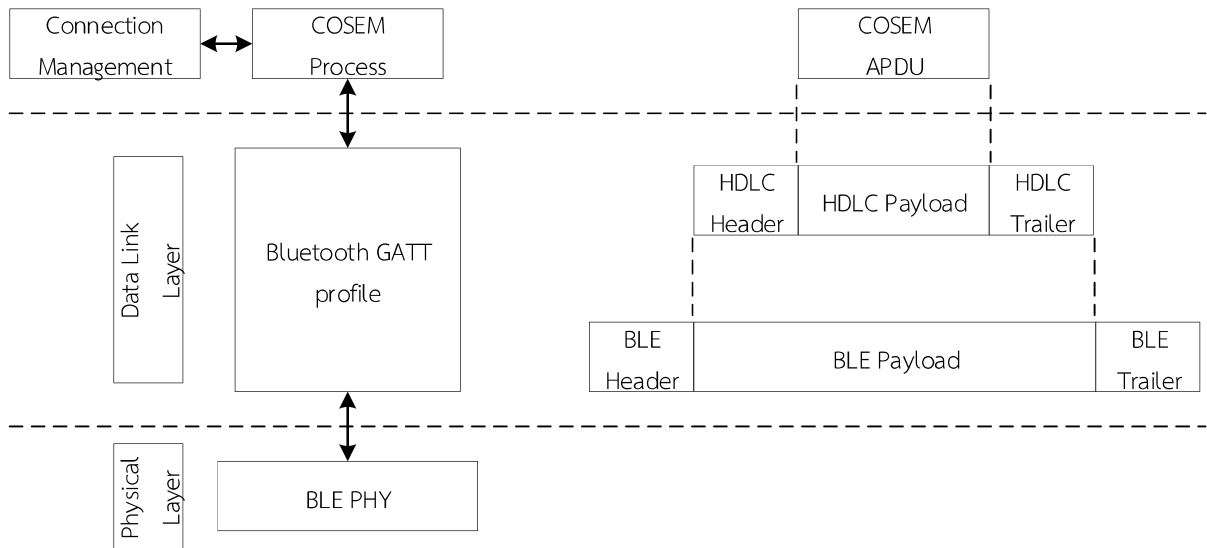


Figure 1A: HDLC communication profile

2. Billing Data

Typical purpose of billing data is the reported of energy consumption of electronic meters. The billing data are modeled as Profile Generic Interface Class (class\_id = 7). The parameters for Profile Generic IC are specified in Table 1A. The OBIS code of billing Data is 1-0:98.1.0.255. The capture objects are specified in Table 2A for 1-phase meters and in Table 3A for 3-phase meters.

The meters shall be able to record at least 12 billing periods of the billing data.



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**Table 1A**

**Billing Parameters**

Billing Data (OBIS code: 1-0:98.1.0.255)				Access Right	Remark
Attributes			Data type	MR	
1	logical_name	(static)	octet-string	R	
2	buffer	(dyn.)	array	R	
3	capture_objects	(static)	array	R	
4	capture_period	(static)	double-long-unsigned	R	0 ; Asynchronous
5	sort_method	(static)	enum	R	(1) FIFO
6	sort_object	(static)	capture_object_definition	R	0
7	entries_in_use	(dyn.)	double-long-unsigned	R	
8	profile_entries	(static)	double-long-unsigned	R	
Specific methods			m/o		
1	reset (data)		o		Use to clear billing data
2	capture (data)		m		
3	reserved from previous versions		o		
4	reserved from previous versions		o		

**Table 2A**

**1-phase meter's Billing Capture Objects**

Parameter	OBIS code						Detail	scal_unit_type		Data Type	IC	Attr.
	A	B	C	D	E	F		scaler	unit			
Clock object	0	0	1	0	0	255	Time stamp using system clock			octet-string [9]	8	2
Total kWh (Cumulative)	1	0	1	8	0	255	$\sum$ Li Active power+ (QI+QIV); Time integral 1; Rate 0	0	Wh [30]	double_long_unsigned [6]	3	2
	1	0	2	8	0	255	$\sum$ Li Active power- (QII+QIII); Time integral 1; Rate 0	0	Wh [30]	double_long_unsigned [6]	3	2
Total kWh absolute	1	0	15	8	0	255	$\sum$ Li Active power (abs(QI+QIV)+abs(QII+QIII)); Time integral 1; Rate 0 (0 is total)	0	Wh [30]	double_long_unsigned [6]	3	2
Total kWh net	1	0	16	8	0	255	$\sum$ Li Active power (abs(QI+QIV)-abs(QII+QIII)); Time integral 1; Rate 0 (0 is total)	0	Wh [30]	double_long [5]	3	2
Max. Demand (Last reset)	1	0	1	6	0	255	$\sum$ Li Active power+ (QI+QIV); Max.	0	W [27]	double_long_unsigned [6]	4	2
	1	0	2	6	0	255	$\sum$ Li Active power- (QII+QIII); Max.	0	W [27]	double_long_unsigned [6]	4	2
Minimum Voltage	1	0	12	3	0	255	Voltage; Min.	-2	V [35]	long_unsigned [18]	3	2
Alarm Descriptor 1	0	0	97	98	20	255	Alarm Descriptor object 1			double_long_unsigned[6]	1	2
Alarm Discriptor 2	0	0	97	98	21	255	Alarm Descriptor object 2			double_long_unsigned[6]	1	2

Note: The unit of Max. Demand (Last reset) shall be “W” (Watt). PEA’s mobile application will correct the unit of Max. Demand (Last reset) to “kW” (Kilowatt) after reading.



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**Table 3A**

### 3-phase meter's Billing Capture Objects

Parameter	OBIS code						Detail	scal_unit_type		Data Type	IC	Attr.
	A	B	C	D	E	F		scaler	unit			
Clock object	0	0	1	0	0	255	Time stamp using system clock			octet-string [9]	8	2
Total kWh (Cumulative)	1	0	1	8	0	255	$\sum$ Li Active power+ (QI+QIV); Time integral 1; Rate 0	0	Wh [30]	double_long_unsigned [6]	3	2
	1	0	2	8	0	255	$\sum$ Li Active power- (QII+QIII); Time integral 1; Rate 0	0	Wh [30]	double_long_unsigned [6]	3	2
Total kWh absolute	1	0	15	8	0	255	$\sum$ Li Active power (abs(QI+QIV)+abs(QII+QIII)); Time integral 1; Rate 0 (0 is total)	0	Wh [30]	double_long_unsigned [6]	3	2
Total kWh net	1	0	16	8	0	255	$\sum$ Li Active power (abs(QI+QIV)-abs(QII+QIII)); Time integral 1; Rate 0 (0 is total)	0	Wh [30]	double_long [5]	3	2
Max. Demand (Last reset)	1	0	1	6	0	255	$\sum$ Li Active power+ (QI+QIV); Max.	0	W [27]	double_long_unsigned [6]	4	2
	1	0	2	6	0	255	$\sum$ Li Active power- (QII+QIII); Max.	0	W [27]	double_long_unsigned [6]	4	2
Minimum Voltage of L1	1	0	32	3	0	255	L1 Voltage; Min.	-2	V [35]	long_unsigned [18]	3	2
Minimum Voltage of L2	1	0	52	3	0	255	L2 Voltage; Min.	-2	V [35]	long_unsigned [18]	3	2
Minimum Voltage of L3	1	0	72	3	0	255	L3 Voltage; Min.	-2	V [35]	long_unsigned [18]	3	2
Alarm Descriptor 1	0	0	97	98	20	255	Alarm Descriptor object 1			double_long_unsigned[6]	1	2
Alarm Discriptor 2	0	0	97	98	21	255	Alarm Descriptor object 2			double_long_unsigned[6]	1	2

Note: 1. The unit of Max. Demand (Last reset) shall be “W” (Watt). PEA’s mobile application will correct the unit of Max. Demand (Last reset) to “kW” (Kilowatt) after reading.

2. Minimum Voltage (L1, L2, L3) is the smallest of last averaged instantaneous voltage value per phase, by which the instantaneous voltage will be averaged within a window of 60 seconds, during a billing period.



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### 3. Load Profile Data

Typical purpose of load profile data is the consumption record management along the time. The load profile data are modeled as Profile Generic Interface Class (class\_id = 7). The parameters for Profile Generic IC are specified in **Table 4A**. The OBIS code of Load Profile Data is 1-0:99.1.0.255. The capture objects are specified in **Table 5A** for 1-phase meters and in **Table 6A** for 3-phase meters.

**Table 4A**

**Load Profile Parameters**

Load Profile Data (OBIS code: 1-0:99.1.0.255)				Access Right	Remark
Attributes			Data type	MR	
1	logical_name	(static)	octet-string	R	
2	buffer	(dyn.)	array	R	
3	capture_objects	(static)	array	R	
4	capture_period	(static)	double-long-unsigned	R	900 s (15 min.)
5	sort_method	(static)	enum	R	(1) FIFO
6	sort_object	(static)	capture_object_definition	R	0
7	entries_in_use	(dyn.)	double-long-unsigned	R	
8	profile_entries	(static)	double-long-unsigned	R	
Specific methods			m/o		
1	reset (data)		o		Use to clear load profile
2	capture (data)		o		
3	reserved from previous versions		o		
4	reserved from previous versions		o		

**Table 5A**

**1-Phase Meters Capture Objects**

Parameter	OBIS code						Detail	scal_unit_type		Data Type	IC	Attr.
	A	B	C	D	E	F		scaler	unit			
Clock object	0	0	1	0	0	255	Time stamp using system clock			octet-string [9]	8	2
Status	0	0	96	10	1	255	Profile Status			unsigned [17]	1	2
Voltage: Avg. value (V)	1	0	12	27	0	255	Voltage;; 15 mins. Avg. value;	-2	V [35]	long_unsigned [18]	3	2
Demand	1	0	1	27	0	255	$\sum$ Li Active power+ (QI+QIV); Avg. Value	0	W [27]	double_long_unsigned [6]	3	2
	1	0	2	27	0	255	$\sum$ Li Active power- (QII+QIII); Avg. Value	0	W [27]	double_long_unsigned [6]	3	2

Note: The unit of Demand shall be “W” (Watt). PEA’s mobile application will correct the unit of Demand to “kW” (Kilowatt) after reading.





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**Table 6A**

### 3-Phase Meters Capture Objects

Parameter	OBIS code						Detail	scal_unit_type		Data Type	IC	Attr.
	A	B	C	D	E	F		scaler	unit			
Clock object	0	0	1	0	0	255	Time stamp using system clock			octet-string [9]	8	2
Status	0	0	96	10	1	255	Profile Status			unsigned [17]	1	2
Voltage: Avg. value (V)	1	0	32	27	0	255	Voltage L1;; 15 mins. Avg. value;	-2	V [35]	long_unsigned [18]	3	2
	1	0	52	27	0	255	Voltage L2;; 15 mins. Avg. value;	-2	V [35]	long_unsigned [18]	3	2
	1	0	72	27	0	255	Voltage L3;; 15 mins. Avg. value;	-2	V [35]	long_unsigned [18]	3	2
Demand	1	0	1	27	0	255	$\Sigma$ Li Active power+ (QI+QIV); Avg. Value	0	W [27]	double_long_unsigned [6]	3	2
	1	0	2	27	0	255	$\Sigma$ Li Active power- (QII+QIII); Avg. Value	0	W [27]	double_long_unsigned [6]	3	2

Note: The unit of Demand shall be “W” (Watt). PEA’s mobile application will correct the unit of Demand to “kW” (Kilowatt) after reading.

The following function describes the state and function of all bits:

**Table 7A**

### Load Profile Status

Bit	Flag	Description
7	PDN	Power down: This bit is set to indicate that an all-phase power failure occurred.
6	0	Not use
5	CAD	Clock adjusted: The bit is set when clock has been adjusted more than the synchronization limit. At the same time the DNV flag is set because the capture period deviates from its nominal lengths and shall not be used for billing.
4	0	Not use
3	0	Not use
2	DNV	Data not valid: Indicates that the current entry cannot be used for billing e.g. due to time shift or if no values have been recorded during the capture period.
1	CIV	Clock invalid: The power reserve of the calendar clock has been exhausted. The time is declared as invalid. At the same time the DNV bit is set.
0	ERR	Critical error: A serious error such as a hardware failure or a checksum error has occurred. At the same time, the DNV bit is set.



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#### 4. Alarms

Some events listed in **Annex 3** can trigger alarms. If one of these events occurs, then the corresponding flag in the alarm register is set high. Unwanted alarms can be masked out by the programmed alarm filters. The trigger of a given alarm bit may be originated from diverse events; therefore, the alarm event only provides to Smart Device, an insight of the device situation. A deeper knowledge of the device diagnostic (what kind of event? when? and why?) needs the reading of the related event logs involved. The alarm register 1 structure and alarm register 2 structure are displayed in **Annex 2**.

##### 4.1 Alarm management

**Table 8A** specifies the alarm processing supported by the objects

**Table 8A**  
**Required Objects for Alarms**

Parameter	OBIS code						Detail	Data Type	IC	Attr.
	A	B	C	D	E	F				
Alarm register 1	0	0	97	98	0	255	Alarm register object; #1	double_long_unsigned [6]	1	2
Alarm register 2	0	0	97	98	1	255	Alarm register object; #2	double_long_unsigned [6]	1	2
Alarm Filter 1	0	0	97	98	10	255	Alarm filter object; #1	double_long_unsigned [6]	1	2
Alarm Filter 2	0	0	97	98	11	255	Alarm filter object; #2	double_long_unsigned [6]	1	2
Alarm Descriptor 1	0	0	97	98	20	255	Alarm descriptor object; #1	double_long_unsigned [6]	1	2
Alarm Descriptor 2	0	0	97	98	21	255	Alarm descriptor object; #2	double_long_unsigned [6]	1	2

##### 4.2 Alarm processing

Alarm Registers:

- Alarm register contains all information on the cause of the alarm.
- Specific bits of alarm registers may be internally reset if the cause of the alarm has been cleared. Alternatively, all bits may be externally reset by the client by executing a SET=0 service to the alarm registers' attribute, value.

Alarm Filters:

- The alarm filters have exactly the same structure of the alarm registers. Alarm filters are used to filter out unwanted alarms. The alarm is enabled when a bit in the alarm register is set by the meter and the corresponding bit in the alarm filter is set.

Alarm Descriptors:

- The alarm descriptors have exactly the same structure of the alarm registers. Whenever a bit in the alarm registers changes from 0 to 1 then the corresponding bit in the alarm descriptor is set to 1. Resetting the alarm registers does not affect the alarm descriptors. The set bits of the alarm descriptor must be reset explicitly in order to acknowledge that the alarm has been correctly received.



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#### 4.3 Alarm clearance

When an event, which has not been filtered out occurs, an alarm is triggered. The alarm descriptors are held data notification which has been configured via the alarm monitors. To acknowledge the reception of an alarm, the appropriate bits in the alarm descriptors and the alarm registers must be to reset by Smart Device.

#### 5. Power Quality Log

Typical purpose of power quality log is the reported of power quality log of electronic meter. The power quality log is modeled as Profile Generic Interface Class (class\_id = 7). The parameters for Profile Generic IC are specified in **Table 9A**. The OBIS code of power quality log is 0-0:99.98.0.255. The capture objects are specified in **Table 10A** for 1-phase meters and in **Table 11A** for 3-phase meters.

**Table 9A**

**Power Quality Log Parameters**

Power Quality Log (OBIS code: 0-0:99.98.0.255)				Access Right	Remark
Attributes			Data type	MR	
1	logical_name	(static)	octet-string	R	
2	buffer	(dyn.)	array	R	
3	capture_objects	(static)	array	R	
4	capture_period	(static)	double-long-unsigned	R	
5	sort_method	(static)	enum	R	(1) FIFO
6	sort_object	(static)	capture_object_definition	R	0
7	entries_in_use	(dyn.)	double-long-unsigned	R	
8	profile_entries	(static)	double-long-unsigned	R	
Specific methods			m/o		
1	reset (data)		o		Use to clear power quality log
2	capture (data)		o		
3	reserved from previous versions		o		
4	reserved from previous versions		o		

**Table 10A**

**1-Phase Meters Capture Objects**

Parameter	OBIS code						Detail	scal_unit_type		Data Type	IC	Attr.
	A	B	C	D	E	F		scaler	unit			
Clock object	0	0	1	0	0	255	Time stamp using system clock			octet-string [9]	8	2
Event Object – Power Quality Log	0	0	96	11	0	255	Event Object – Power Quality Log			unsigned [17]	1	2
Instantaneous Voltage	1	0	12	7	0	255	Voltage; any phase; Inst. value	-2	V [35]	long_unsigned [18]	3	2



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**Table 11A**

#### 3-Phase Meters Capture Objects

Parameter	OBIS code						Detail	scal_unit_type		Data Type	IC	Attr.
	A	B	C	D	E	F		scaler	unit			
Clock object	0	0	1	0	0	255	Time stamp using system clock			octet-string [9]	8	2
Event Object – Power Quality Log	0	0	96	11	0	255	Event Object – Power Quality Log			unsigned [17]	1	2
Instantaneous Voltage phase 1	1	0	32	7	0	255	L1 Voltage; Inst. value	-2	V [35]	long_unsigned [18]	3	2
Instantaneous Voltage phase 2	1	0	52	7	0	255	L2 Voltage; Inst. value	-2	V [35]	long_unsigned [18]	3	2
Instantaneous Voltage phase 3	1	0	72	7	0	255	L3 Voltage; Inst. value	-2	V [35]	long_unsigned [18]	3	2

#### 6. Access Right

The **Table 12A** is describes the access right for both 1-phase and 3-phase energy meter.

**Table 12A**

#### The access right

Access Right Definitions		Detail
MR	Meter Reader	Contexts with Low Level Security (low level security)

#### 7. Bluetooth Communication Profile

Bluetooth version: 4.2, or later version

Bluetooth profile: Generic Attribute Profile (GATT)



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#### ANNEX 2

#### Alarm register structure

#### 1 Alarm register 1 structure

Table 1B

Alarm register 1 structure

Bit	Alarm Name	Triggering Event
0	Clock invalid	-
1	Reserved for future use	-
2	Reserved for future use	-
3	Reserved for future use	-
4	Reserved for future use	-
5	Reserved for future use	-
6	Reserved for future use	-
7	Reserved for future use	-
8	Program memory error	-
9	Reserved for future use	-
10	Reserved for future use	-
11	Reserved for future use	-
12	Reserved for future use	-
13	Tamper detection: Missing neutral detection (only for 1-phase meters)	-
14	Tamper detection: Phase and neutral interchange (only for 1-phase meters) (Phase and neutral interchange will be effective with bid invitation date from 1 <sup>st</sup> January 2022)	-
15	Tamper detection: Incoming and outgoing interchange detection (only for 3-phase meters)	-
16	Tamper detection: Terminal cover is opened (only for 3-phase meters)	-
17	Reserved for future use	-
18	Reserved for future use	-
19	Reserved for future use	-
20	Reserved for future use	-
21	Reserved for future use	-



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Bit	Alarm Name	Triggering Event
22	Reserved for future use	-
23	Reserved for future use	-
24	Reserved for future use	-
25	Reserved for future use	-
26	Reserved for future use	-
27	Reserved for future use	-
28	Reserved for future use	-
29	Reserved for future use	-
30	Reserved for future use	-
31	Reserved for future use	-

## 2 Alarm register 2 structure

Table 2B

Alarm register 2 structure

Bit	Alarm Name	Triggering Event
0	Total Power Failure	-
1	Power Resume (all phases)	-
2	Voltage Missing Phase L1	-
3	Voltage Missing Phase L2 (only for 3-phase meters)	-
4	Voltage Missing Phase L3 (only for 3-phase meters)	-
5	Voltage Normal Phase L1	-
6	Voltage Normal Phase L2 (only for 3-phase meters)	-
7	Voltage Normal Phase L3 (only for 3-phase meters)	-
8	Reserved for future use	-
9	Reserved for future use	-
10	Current Reversal	-
11	Wrong Phase Sequence (only for 3-phase meters)	-
12	Reserved for future use	-



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Bit	Alarm Name	Triggering Event
13	Reserved for future use	-
14	Bad Voltage Quality L1	PQ 202
15	Bad Voltage Quality L2 (only for 3-phase meters)	PQ 203
16	Bad Voltage Quality L3 (only for 3-phase meters)	PQ 204
17	Reserved for future use	-
18	Local communication attempt (during attempt to connect)	-
19	Reserved for future use	-
20	Reserved for future use	-
21	Reserved for future use	-
22	Reserved for future use	-
23	Reserved for future use	-
24	Reserved for future use	-
25	Reserved for future use	-
26	Reserved for future use	-
27	Reserved for future use	-
28	Reserved for future use	-
29	Reserved for future use	-
30	Reserved for future use	-
31	Reserved for future use	-



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#### ANNEX 3

#### Event code

#### 1 Overview

The managed events are dispatched in different logs depending on the kind of event occurred. These logs are Power Quality log. The logbook only records events belonging to its category, such a way that event IDs have to be categorized by the logbook they belong to.

#### 2 Power Quality events

The following event\_ID belong to the Power Quality logs

Table 1C

Power Quality Logs Event Table

No	Name	Description	PQ Log
1	Reserved for future use		
...	Reserved for future use		
84	Reserved for future use		
85	Voltage L1 normal	Indicates that the mains voltage is in normal limits (230/400 ± 10 % V) again, e.g. after under/overvoltage.	x
86	Voltage L2 normal (only for 3-phase meters)	Indicates that the mains voltage is in normal limits (230/400 ± 10 % V) again, e.g. after under/overvoltage.	x
87	Voltage L3 normal (only for 3-phase meters)	Indicates that the mains voltage is in normal limits (230/400 ± 10 % V) again, e.g. after under/overvoltage.	x
88	Reserved for future use		
...	Reserved for future use		
201	Reserved for future use		
202	Under Voltage of L1	The voltage is lower than the normal operating voltage of the meter, according to <b>1c.5.5 Over and under voltage detection.</b>	x
203	Under Voltage of L2 (only for 3-phase meters)	The voltage is lower than the normal operating voltage of the meter, according to <b>1c.5.5 Over and under voltage detection.</b>	x
204	Under Voltage of L3 (only for 3-phase meters)	The voltage is lower than the normal operating voltage of the meter, according to <b>1c.5.5 Over and under voltage detection.</b>	x





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No	Name	Description	PQ Log
205	<i>manufacturer specific</i>		
...	<i>manufacturer specific</i>		
208	<i>manufacturer specific</i>		
209	Over Voltage of L1	The voltage is over than the normal operating voltage of the meter, according to <b>1c.5.5 Over and under voltage detection.</b>	x
210	Over Voltage of L2 (only for 3-phase meters)	The voltage is over than the normal operating voltage of the meter, according to <b>1c.5.5 Over and under voltage detection.</b>	x
211	Over Voltage of L3 (only for 3-phase meters)	The voltage is over than the normal operating voltage of the meter, according to <b>1c.5.5 Over and under voltage detection.</b>	x
212	<i>manufacturer specific</i>		
...	<i>manufacturer specific</i>		
253	<i>manufacturer specific</i>		
254	Load profile cleared	Any of the profiles cleared.  NOTE: If it appears in Standard Event Log then any of the E-load profiles was cleared. If the event appears in the M-Bus Event log then one of the MBus load profiles was cleared	
255	Event log cleared	Indicates that the event log was cleared. This is always the first entry in an event log. It is only stored in the affected event log.	x



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### เอกสารเพิ่มเติมแนบท้ายรายละเอียดสเปค 1 (ADDENDUM 1)

เอกสารเพิ่มเติม (ADDENDUM) นี้ถือให้เป็นส่วนหนึ่งของรายละเอียดสเปคอ้างอิงเลขที่ RMTR-038/2564

แผนและวิธีการชักตัวอย่าง โดยระบุขีดจำกัดคุณภาพที่ยอมรับ ตามมาตรฐานผลิตภัณฑ์อุตสาหกรรม มาตรฐาน เลขที่ มอก. 465 – 2554 หรือ IEC 62058-11/2010 Part 11: General acceptance inspection methods เพื่อใช้สำหรับการพิจารณาผลการตรวจรับ

#### 1. แผนการชักตัวอย่าง และขนาดของกลุ่มตัวอย่าง

1.1 ระดับคุณภาพที่ยอมรับ (Acceptance Quality Level: AQL) กำหนดให้เป็นร้อยละ 1.0

1.2 กรณีผู้ประกอบการภายในประเทศ จะดำเนินการชักตัวอย่างโดยใช้แบบแผนการชักตัวอย่างแบบ Double sampling ตามตารางที่ 1

1.3 กรณีผู้ประกอบการต่างประเทศ จะดำเนินการชักตัวอย่างโดยใช้แบบแผนการชักตัวอย่างแบบ Single sampling ตามตารางที่ 2

#### 2. การสุ่มตัวอย่าง และเกณฑ์การตัดสินใจ

2.1 การสุ่มตัวอย่างจะใช้วิธีการทางสถิติ (Simple random sampling) และทำการทดสอบตามข้อ 4.1

2.2 กรณีผู้ประกอบการภายในประเทศ มีวิธีการสุ่มตัวอย่างและเกณฑ์การตัดสินใจตามรูปที่ 1

2.2.1 การสุ่มตัวอย่างครั้งที่ 1 จะดำเนินการสุ่มตัวอย่างที่โรงงานผู้ผลิต โดยผู้ประกอบการต้องจัดวางมิเตอร์ให้สามารถนำมิเตอร์ที่ได้จากการสุ่มมาทดสอบเพื่อการตรวจรับได้โดยง่าย

2.2.2 การสุ่มตัวอย่างครั้งที่ 2 จะดำเนินการสุ่มตัวอย่าง กคพ.3 ริงสิต ปทุมธานี

#### ตารางที่ 1 การชักตัวอย่างแบบแผน Double sampling (Normal Inspection)

จำนวนมิเตอร์ ต่อ Lot	Sample	ปริมาณ Sample (n <sub>1</sub> , n <sub>2</sub> )	รวมจำนวน	Acceptance number (Ac <sub>1</sub> , Ac <sub>2</sub> )	Rejection number (Re <sub>1</sub> , Re <sub>2</sub> )
≤280	1 <sup>st</sup>	32	32	0	2
	2 <sup>nd</sup>	32	64	1	2
281 – 500	1 <sup>st</sup>	50	50	0	3
	2 <sup>nd</sup>	50	100	3	4
501 – 1200	1 <sup>st</sup>	80	80	1	3
	2 <sup>nd</sup>	80	160	4	5
≥1201	1 <sup>st</sup>	125	125	2	5
	2 <sup>nd</sup>	125	250	6	7

หมายเหตุ

Ac<sub>1</sub> = Acceptance number Sample ครั้งที่ 1

Ac<sub>2</sub> = Acceptance number Sample ครั้งที่ 2

n<sub>1</sub> = จำนวนตัวอย่างครั้งที่ 1

Re<sub>1</sub> = Rejection number Sample ครั้งที่ 1

Re<sub>2</sub> = Rejection number Sample ครั้งที่ 2

n<sub>2</sub> = จำนวนตัวอย่างครั้งที่ 2



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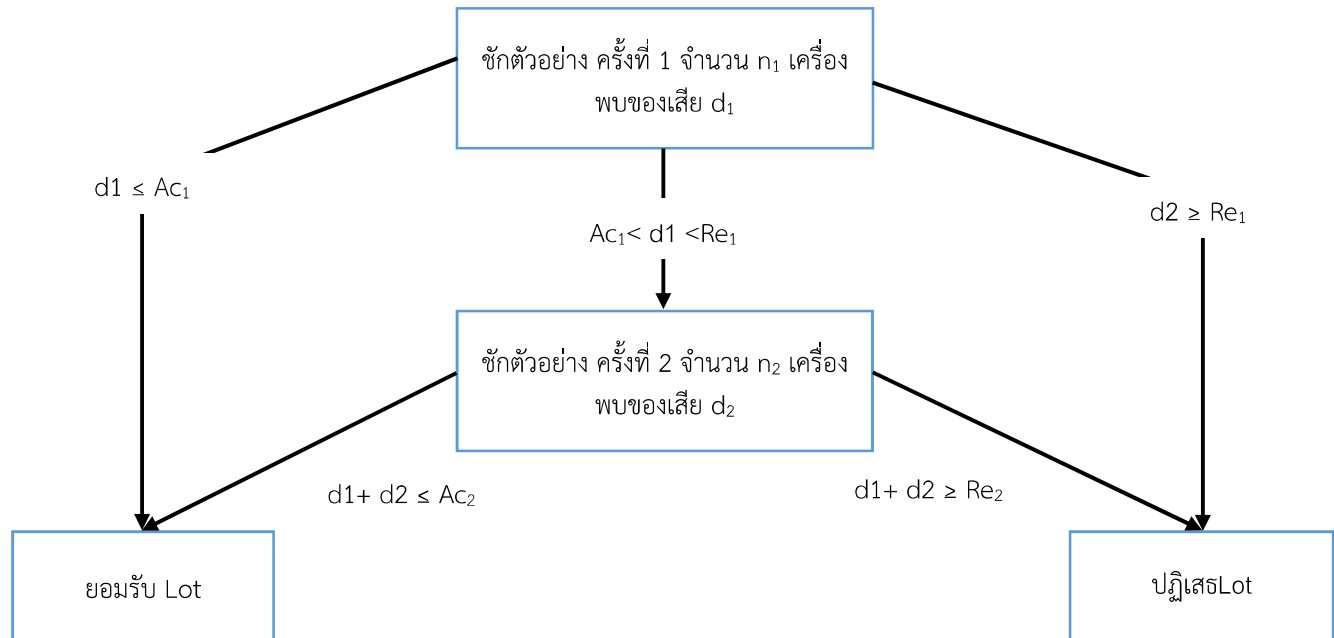
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#### ตารางที่ 2 การชักตัวอย่างแบบแผน Single sampling (Normal Inspection)

จำนวนมิเตอร์ต่อ Lot	ปริมาณ Sample (n)	Acceptance number (Ac)	Rejection number (Re)
≤90	20	0	1
91 – 150	32	1	2
151 – 280	50	1	2
281 – 500	80	2	3
501 – 1200	125	3	4
≥1201	200	5	6



#### รูปที่ 1 วิธีการสุ่มตัวอย่างและเกณฑ์การตัดสินใจ กรณีผู้ประกอบการภายในประเทศ

##### (1) กรณีการสุ่มครั้งที่ 1

ในกรณีพบมิเตอร์ที่ไม่ผ่านคุณสมบัติตามเงื่อนไขที่ระบุในสเปค จำนวนน้อยกว่าหรือเท่ากับ  $Ac_1$  เครื่อง ถือว่าผลการทดสอบเป็นที่ยอมรับได้ ไม่ต้องสุ่มตรวจซ้ำในครั้งที่ 2 และผู้ประกอบการต้องดำเนินการแก้ไขพัสดุที่ไม่ผ่านการทดสอบให้ถูกต้องตามข้อกำหนดของ กฟผ.

ในกรณีพบมิเตอร์ที่ไม่ผ่านคุณสมบัติตามเงื่อนไขที่ระบุในสเปค จำนวนตั้งแต่  $Ac_1$  เครื่อง ขึ้นไปแต่ไม่เกิน  $Re_1$  เครื่อง ให้ดำเนินการสุ่มต่อในครั้งที่ 2

ในกรณีพบมิเตอร์ที่ไม่ผ่านคุณสมบัติตามเงื่อนไขที่ระบุในสเปค จำนวนมากกว่าหรือเท่ากับ  $Re_1$  เครื่อง จะไม่ผ่านการตรวจรับ และผู้ประกอบการต้องดำเนินการแก้ไขพัสดุใน Lot นั้นทั้งหมด รวมถึงหาข้อบกพร่องหรือสาเหตุที่ทำให้เกิดความผิดปกติ พร้อมดำเนินการปรับปรุงกระบวนการผลิต และยื่นรายงานผลการปรับปรุงกระบวนการผลิต และควบคุมคุณภาพให้ กฟผ. พร้อมการส่งมอบพัสดุที่ได้ปรับปรุงแก้ไขแล้ว และถือว่ารายงานนั้นเป็นส่วนหนึ่งในการพิจารณาผลการตรวจรับ โดยให้เริ่มกระบวนการตรวจรับและสุ่มทดสอบตั้งแต่ครั้งที่ 1



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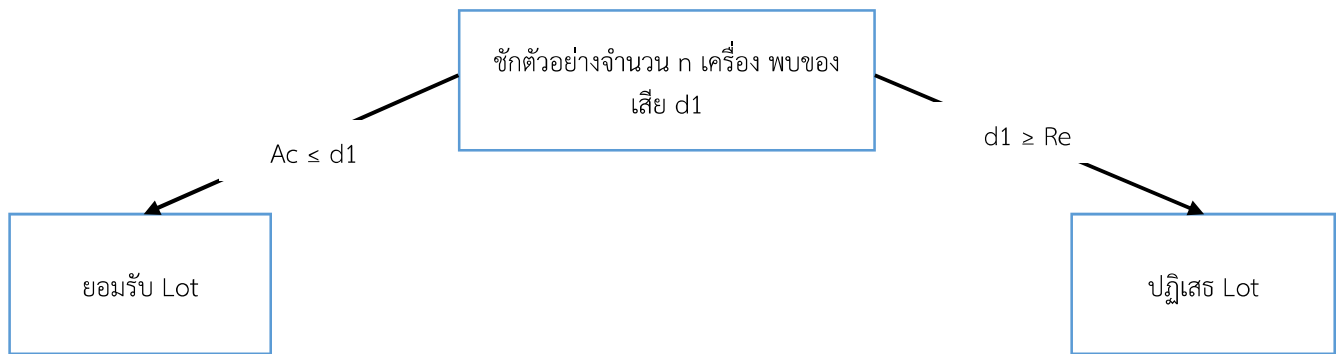
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#### (2) กรณีการสุ่มครั้งที่ 2

ในกรณีพบมิเตอร์ที่ไม่ผ่านคุณสมบัติตามเงื่อนไขที่ระบุในสเปค รวมกันในการสุ่มครั้งที่ 1 และครั้งที่ 2 เป็นจำนวนไม่เกิน  $Ac_2$  เครื่อง ถือว่าผลการทดสอบเป็นที่ยอมรับได้ และผู้ประกอบการต้องดำเนินการแก้ไขพัสดุที่ไม่ผ่านการทดสอบให้ถูกต้องตามข้อกำหนดของ กฟผ.

ในกรณีพบมิเตอร์ที่ไม่ผ่านคุณสมบัติตามเงื่อนไขที่ระบุในสเปค รวมกันในการสุ่มครั้งที่ 1 และครั้งที่ 2 เป็นจำนวนมากกว่าหรือเท่ากับ  $Re_2$  เครื่องขึ้นไป จะไม่ผ่านการตรวจรับ และผู้ประกอบการต้องดำเนินการแก้ไขพัสดุใน Lot นั้นทั้งหมด รวมถึงหาข้อบกพร่องหรือสาเหตุที่ทำให้เกิดความผิดปกติ พร้อมดำเนินการปรับปรุงกระบวนการผลิต และยื่นรายงานผลการปรับปรุงกระบวนการผลิต และควบคุมคุณภาพให้ กฟผ. พร้อมการส่งมอบพัสดุที่ได้ปรับปรุงแก้ไขแล้ว และถือว่ารายงานนั้นเป็นส่วนหนึ่งในการพิจารณาผลการตรวจรับ โดยให้เริ่มกระบวนการตรวจรับและสุ่มทดสอบตั้งแต่ครั้งที่ 1 ใหม่อีกครั้ง

#### 2.3 กรณีผู้ประกอบการต่างประเทศ มีวิธีการสุ่มตัวอย่างและเกณฑ์การตัดสินตามรูปที่ 2



#### รูปที่ 2 วิธีการสุ่มตัวอย่างและเกณฑ์การตัดสินกรณีผู้ประกอบการต่างประเทศ

2.3.1 การสุ่มตัวอย่าง จะดำเนินการสุ่มตัวอย่างเพียงครั้งเดียวที่ กคพ.3 รั้งสิต ปทุมธานี หลังจากที่มีการรับฝากสินค้าจากผู้ประกอบการแล้ว

#### 2.3.2 เกณฑ์การตัดสิน

ในกรณีพบมิเตอร์ที่ไม่ผ่านคุณสมบัติตามเงื่อนไขที่ระบุในสเปค จำนวนไม่เกิน  $Ac$  เครื่อง ถือว่าผลการทดสอบเป็นที่ยอมรับได้ และผู้ประกอบการต้องดำเนินการแก้ไขพัสดุที่ไม่ผ่านการทดสอบให้ถูกต้องตามข้อกำหนดของ กฟผ.

ในกรณีพบมิเตอร์ที่ไม่ผ่านคุณสมบัติตามเงื่อนไขที่ระบุในสเปค จำนวนตั้งแต่  $Re$  เครื่องขึ้นไป จะไม่ผ่านการตรวจรับ และผู้ประกอบการต้องดำเนินการแก้ไขพัสดุใน Lot นั้นทั้งหมด รวมถึงหาข้อบกพร่องหรือสาเหตุที่ทำให้เกิดความผิดปกติ พร้อมดำเนินการปรับปรุงกระบวนการผลิต และยื่นรายงานผลการปรับปรุงกระบวนการผลิตและควบคุมคุณภาพให้ กฟผ. พร้อมการส่งมอบพัสดุที่ได้ปรับปรุงแก้ไขแล้ว และถือว่ารายงานนั้นเป็นส่วนหนึ่งในการพิจารณาผลการตรวจรับ โดยให้เริ่มกระบวนการตรวจรับและสุ่มทดสอบตั้งแต่ต้น

2.4 เฉพาะการตรวจรับมิเตอร์ Lot ที่ 1 กฟผ. จะทำการสุ่มมิเตอร์จำนวน 1 เครื่อง เพื่อทดสอบในหัวข้อ Tests of insulation properties, Tests for electromagnetic compatibility, Tests of the effect of the climatic environments และ Mechanical tests ตามข้อ 4.2 ทั้งกรณีผู้ประกอบการในประเทศ และผู้ประกอบการต่างประเทศ หากผลการทดสอบไม่ผ่าน กฟผ. จะถือว่าไม่ผ่านการตรวจรับ และผู้ประกอบการต้องดำเนินการแก้ไขพัสดุใน Lot นั้นทั้งหมด รวมถึงหาข้อบกพร่องหรือสาเหตุที่ทำให้เกิดความผิดปกติ พร้อมดำเนินการปรับปรุงกระบวนการผลิต และยื่นรายงานผลการปรับปรุงกระบวนการผลิต และควบคุมคุณภาพให้ กฟผ. พร้อมการส่งมอบพัสดุที่ได้ปรับปรุงแก้ไขแล้ว และถือว่ารายงานนั้นเป็นส่วนหนึ่งในการพิจารณาผลการตรวจรับ โดยให้เริ่มกระบวนการตรวจรับและสุ่มทดสอบตั้งแต่ต้น