

CHAPTER 9 – ENERGY METERING
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CHAPTER 9 – ENERGY METERING

9.1 SCOPE

This Specification covers the general requirements of the design, engineering, manufacturing, assembly and inspection & testing of CT/ VT connected, Programmable Static Poly Phase Energy Meter (herein after referred to as “The Meter” in this specification) of Accuracy Class 0.2S with Time of Day Reading Facility and option for remote reading. The meters shall be used for commercial/ tariff metering for inter License power flows/ bulk consumers application and suitable for operation on either MV or HV application as specified.

The meter shall have wide secondary current range support i.e. same meter shall be put up for 1A or 5A rating as per field availability of CT’s. Meter required to be commissioned at each substation shall be of 3 phase 4 wire or 3 phase 3 wire.

The Meter shall have the facility to programme and read from a PC connected to the meter using USB and Optical port. Meter shall also have the communication facility to take the meter reading and any other data remotely via a data communication network. The communication modules including accessories required at both local and remote ends and software for remote meter reading shall be supplied with the meter. It shall be possible to replace the communication unit at site without breaking the meter calibration seals.

Following items shall be supplied for the offer

- 1) The meter as specified
- 2) Communication module for the meter including accessories
- 3) Communication module for the PC including accessories
- 4) PC software and accessories including optical cable for local configuration (One optical cable for each 50 Nos. meters shall be provided)

9.2 APPLICABLE STANDARDS

The equipment and components supplied shall be designed manufactured and tested in accordance with the latest editions/amendments of the Standards specified below. However, the CEB Specification shall supersede these standards in the event there is a discrepancy.

S.N.	Standard No.	Title
a.	IEC 62052-11	Electricity metering equipment (AC) – General requirements, tests, and test conditions- Part 11: Metering equipment
b.	IEC 62053-22	Electricity metering equipment (AC) Particular requirements - Part 22: Static meters for active energy (classes 0.2S and 0.5)
c.	IEC 62053-23	Electricity metering equipment (AC) Particular requirements - Part 23: Static meters for reactive energy (classes 2 and 3)
d.	IEC 62058-11	Electricity metering equipment (A.C) – Acceptance inspection- Part 11: General acceptance inspection methods
e.	IEC 62058-31	Electricity metering equipment (A.C) – Acceptance inspection- Part 31: Particular requirements for static meters for active energy (Class 0.2S, 0.5S, 1 and 2)
f.	IEC 62056-21	Electricity metering - Data exchange for meter reading, tariff and load control

		Part 21: Direct local data exchange
g.	IEC 62056-42	Electricity metering - Data exchange for meter reading, tariff and load control Part 42: Physical layer services and procedures for connection-oriented asynchronous data exchange
h.	IEC 62056-4-7	Electricity metering data exchange –The DLMS/COSEM suite – Part 4-7: DLMS/COSEM transport layer for IP networks
i.	IEC 62056-52	Electricity metering - Data exchange for meter reading, tariff and load control Part 52: Communication protocols management distribution line message specification (DLMS) server
j.	IEC 62056-5-3	Electricity metering data exchange –The DLMS/COSEM suite – Part 5-3: DLMS/COSEM application layer
k.	IEC 62056-6-1	Electricity metering data exchange –The DLMS/COSEM suite – Part 6-1: Object Identification System (OBIS)
l.	IEC 62056-6-2	Electricity metering data exchange –The DLMS/COSEM suite – Part 6-2: COSEM interface classes
m.		
n.	IEC 60529	Degrees of protection provided by enclosures (IP code)
o.	ISO 75	Plastics — Determination of temperature of deflection under load
p.	ISO 9001	Quality management systems - Requirements
q.	ISO/IEC: 17025	General requirements for the competence of testing and calibration laboratories

9.3 METER REQUIREMENT

9.3.1 PRINCIPAL PARAMETERS

i)	Reference Voltage	110 V AC
ii)	Standard Rated Current	1 Amp
iii)	Maximum Current	1.2 x standard rated current
iv)	Auxiliary Supply	60-240 V AC/ DC
v)	Wiring Configuration	3P4W

9.3.2 BASIC FEATURES OF THE METER

9.3.2.1 Measurement

The Meter shall be suitable for full power factor range from zero (lagging) through unity to zero (leading). The Meter shall work as an active energy import and export meter along with reactive (lag and lead) meter. The energy measurement should be true four quadrant type.

The Meter shall be of programmable type suitable for recording active energy consumption in kWh/MWh, reactive energy consumption in kvarh/Mvarh, average demand in kVA/MVA and

kW/MW. The accuracy class of the Meter shall be Class 0.2S for Active Energy and Class 2 or less for reactive Energy.

The Meter shall be suitable for Time-of Day (minimum of 6 intervals), Import-Export Energy Metering. The Meter shall have provisions to change the time of day tariff in the field and shall have facility to programme for a minimum of six (06) times of day tariffs.

Export Energy shall be measured as positive and shall be able to re-programme depending upon the necessity.

The Meter shall record the monthly cumulative consumption of active energy and reactive energy separately. It also shall record the maximum of average apparent and active power demand over a demand integration period of fifteen (15) minutes every month.

9.3.2.2 Operation

The Meters shall detect and record CT polarity reversal as an event with date and time of such occurrence and restoration with phase identification. The Meter shall record the consumption in a separate register with TOD which shall be displayed when required in case polarities are reversed or shall record the consumption correctly even under polarity reversed.

The Meter shall be capable of detecting and recording occurrence of missing voltages and shall display the details of Power disconnections, tampering attempts, power restorations and other details such as time and date of such occurrences.

The Meter shall record the consumption accurately irrespective of the phase sequence of supply.

9.3.2.3 Mounting

The Meter shall be of the indoor type surface mounting, having terminals at the bottom connected with the secondary side of outdoor current and voltage transformers and mounted in suitable panel/ cubicles.

9.3.2.4 Maximum Demand

Facilities shall be provided to reset the maximum demand automatically at a preset date and time as well as manually. It shall be possible to disable the MD reset button and to seal it, if required. It shall also be possible to programme, download data and reset the maximum demand remotely through software running on a PC compatible on latest version of Windows.

9.3.2.5 Security

The Meter shall have necessary security facilities to prevent unauthorized meter parameter changes (password protected). It shall include minimum two levels of authorizations in order to read and programme meters. Facilities shall be provided to modify the password at the meter programming level. A list of set passwords shall be provided with the samples.

9.3.2.6 Flashing Light Indication

Minimum two flashing light indications shall be available on the front face of the Meter which acts as an activity indicator, one LED which blinks analogous to the active energy and another to the reactive energy metered, for testing and calibration purposes. Facilities shall be provided to change the pulse/kWh and pulse/ kvarh to an appropriate value according to the energy flow.

9.3.2.7 Calendar Clock

The Meter shall have a Calendar clock to provide time and date information and be equipped with built in battery backup. Battery life shall be not less than 10 years.

9.3.2.8 Display Sequence

The Meter shall directly display the sequence of data given below. However, it shall be possible to alter the display sequences using the programme software. The Meter display shall have OBIS code or clearly readable meaningful text.

Auto Display Mode

1. Lamp Test
2. Actual Time
3. Actual Date
4. Cumulative Total Active Export Energy
5. Cumulative Active Export Energy (Rate 1)
6. Cumulative Active Export Energy (Rate 2)
7. Cumulative Active Export Energy (Rate 3)
8. Cumulative Total Active Import Energy
9. Cumulative Active Import Energy (Rate 1)
10. Cumulative Active Import Energy (Rate 2)
11. Cumulative Active Import Energy (Rate 3)
12. Maximum Demand (active power)
13. Maximum Demand (apparent power)
14. History 1: Cumulative Total Active Export Energy up to last month reset
15. History 1: Cumulative Active Export Energy (Rate 1) up to last month reset
16. History 1: Cumulative Active Export Energy (Rate 2) up to last month reset
17. History 1: Cumulative Active Export Energy (Rate 3) up to last month reset
18. History 1: Cumulative Total Active Import Energy up to last month reset
19. History 1: Cumulative Active Import Energy (Rate 1) up to last month reset
20. History 1: Cumulative Active Import Energy (Rate 2) up to last month reset
21. History 1: Cumulative Active Import Energy (Rate 3) up to last month reset

Push Button Mode

1. Meter Serial No.
2. History 1: Cumulative Total Active Export Energy
3. History 1: Cumulative Active Export Energy (Rate 1)
4. History 1: Cumulative Active Export Energy (Rate 2)
5. History 1: Cumulative Active Export Energy (Rate 3)
6. History 1: Cumulative Total Active Import Energy
7. History 1: Cumulative Active Import Energy (Rate 1)
8. History 1: Cumulative Active Import Energy (Rate 2)
9. History 1: Cumulative Active Import Energy (Rate 3)
10. History 1: Maximum Demand Export Active Power (MD)
11. Date and Time: History 1: Maximum Demand Export Active Power (MD)
12. History 1: Maximum Demand import Active Power (MD)
13. Date and Time: History 1: Maximum Demand Import Active Power (MD)
14. History 1: Maximum Demand Export Apparent Power (MD)
15. Date and Time: History 1: Maximum Demand Export Apparent Power (MD)
16. History 1: Maximum Demand import Apparent Power (MD)
17. Date and Time: History 1: Maximum Demand Import Apparent Power (MD)
18. MD Reset Date
19. History 1: Cumulative Total Reactive Import Energy

20. History 1: Cumulative Reactive Import Energy (Rate 1)
21. History 1: Cumulative Reactive Import Energy (Rate 2)
22. History 1: Cumulative Reactive Import Energy (Rate 3)
23. History 1: Cumulative Total Reactive Energy Export
24. History 1: Cumulative Reactive Energy Export (Rate 1)
25. History 1: Cumulative Reactive Energy Export (Rate 2)
26. History 1: Cumulative Reactive Energy Export (Rate 3)
27. Maximum Demand Active Power
28. Date and Time : Maximum Demand Active Power
29. Maximum Demand Apparent Power
30. Date and Time : Maximum Demand Apparent Power
31. Phase to Neutral voltage (R)
32. Phase to Neutral voltage (Y)
33. Phase to Neutral voltage (B)
34. R Phase Line current.
35. Y Phase Line current.
36. B Phase Line current.
37. Instantaneous Average power factor.
38. Instantaneous Load Active
39. Instantaneous Load Apparent
40. Phase Sequence ABC (FOR – Correct / REV – Incorrect)
41. Present PT Status
42. Present CT Status
43. LED Pulse Output/ Meter Constant
44. Primary current /CT Ratio
45. Connection Check

Measured energy and maximum demand shall be displayed either in prefix 'kilo' or 'Mega'.

9.3.2.9 Memory

The Meter shall have facilities to store a minimum of twelve months of billing history data, Load Profile data for at least forty five (45) days (Load profile data shall contain parameters, active power, reactive power and apparent power in both directions, power factor, voltage of each phase and current of each phase at 15 minute interval), Event Log Data (minimum 100 records). Each event log or tamper log shall have the date and time of occurrence and restoration. However, these log channels and parameters shall be user configurable. Sampling period for load profile shall be 30s or less. There shall be a facility in the Meter to select average/ maximum/ minimum of the values to be recorded in Load Profile.

It shall have sufficient channels in Load Profile to capture power quality data such as THD in current and voltage

For the display, the Meter shall have non-volatile memory type electronic display. The non-volatile memory shall have a minimum retention time of twelve months. The principle unit for the measured value shall be kilowatt-hour (kWh) and kVA and kW.

9.3.2.10 Meter Programming Facility

It shall be possible to fully program display settings, time of day tariff settings, CT/VT ratios, load profile parameters, automatic billing/resetting date and time, historical registers and other programmable parameters, reset the maximum demand, and download data both locally and remotely through suitable software running on PC without any assistance of the manufacturer.

9.3.3 LOCAL/REMOTE COMMUNICATION

The Meter shall be accessible from the communication software installed and running on Windows based PC supplied by CEB.

The manufacturer shall disclose and provide all necessary protocol information or API(Application Programming Interface) to CEB at any time throughout the guaranteed life span of the Meter, so that independently developed HES(Head End System) and MDMS(Meter Database Management System) can freely communicate with the Meter and manage its data as required.

9.3.3.1 Communication Ports

The Meter shall have following communication ports for local/remote reading:

- i) Optical port (Locally programming and downloading data)
- ii) RS232 port (for remote communication using GSM/GPRS Modem)
- iii) TCP/IP Ethernet (should be configurable on DLMS TCP/MODBUS TCP)

9.3.3.2 Local/Remote Accessibility

Facilities shall be available to carry out following tasks for each of the meter locally/remotely.

- i. To program each meter
- ii. To take the relevant meter readings for each meter separately
- iii. To reset the maximum demand value of each meter.
- iv. To get error messages when the meter is faulty, tampering of meter etc and the date and time of occurrence of such event.
- v. To download stored data from meter (Present values, Historical values, Load Profiles).

9.3.3.3 Methods of Remote Communication

Method for remote communication shall be

- 1. GSM/ GPRS based wireless communication
- 2. CEB communication network based wired communication (Applicable only if the scope of supplier includes supply delivery installation and commissioning)

9.3.3.4 GSM/ GPRS Based Wireless Communication

a) At the Meter end

The Communication Module shall be supplied with the meter and shall be powered from the meter. The module and accessories shall be;

- i. A modem which can operate in 900/1800 MHz (GSM) range and 800/900 MHz (2G) range or 2100 MHz (3G) range or 1800/2300 MHz (4G LTE) range.
- ii. Tamper proof SIM Card Holder
- iii. A built-in connector for an external antenna and antenna cable with 3m wire length
- iv. Minimum speed of 9.600 kbps for GSM, 40 kbps for GPRS, 2 Mbps for 3G and 6 Mbps for 4G
- v. Data cables to connect to meter

b) At the PC end

One GSM/GPRS Communication Module for each lot of 50 meters or part there of shall be supplied with the meter, as specified in the price schedule.

The module shall have;

- ii. A modem which can operate in 900/1800 MHz (GSM) range and 800/900 MHz (2G) range or 2100 MHz (3G) range or 1800/2300 MHz (4G LTE) range.
- iii. Tamper proof SIM Card Holder
- iv. A built-in connector for an external antenna and antenna cable with 3m wire length
- v. Minimum speed of 9.600 kbps for GSM, 40 kbps for GPRS, 2 Mbps for 3G and 6 Mbps for 4G
- vi. Data cables to connect to meter

9.3.3.5 CEB Communication Network Based Wired Communication (Not applicable in case the Scope of supplier is limited to Supply and Delivery of Goods)

There shall be two separate network switches installed at Transco and Disco meter panels. Meters in each panel shall be connected to the respective switch installed at the relevant panel and both these switches shall be linked to two dedicated Ethernet ports in the fiber optic multiplexer in the substation providing remote access to energy meters via CEB communication network.

The network switch shall be of unmanaged industrial type with minimum 24 ethernet ports having speed of 10/100 Mbps. It shall be of rack mountable with fan-less air-cooled cooling system and have LED activity for power and link/activity.

9.3.3.6 Communication Software

A user-friendly windows based Graphical User Interface (GUI) basic software shall be supplied on a CD with the meters in order to programme the meters (locally and remotely) and to download the data from the remote data communication facilitated meters. The software shall have the facility to communicate via a communication modem connected to the PC. Relevant manuals in English language shall be provided.

The downloaded data shall be stored in a suitable fool proof database. This data shall be able to be extracted as a delimited MS Excel format.

Software shall be valid or provided with necessary keys and upgrades for at least the full life span of the Meter. The manufacturer/ supplier shall provide necessary support throughout this period. The software should facilitate remote data downloading individually from each meter as well as batch wise data downloading of particular set of meters through automated function.

9.3.4 MECHANICAL REQUIREMENTS

The Meter shall be designed and constructed in such a way as to avoid introducing any danger in normal use and under normal working conditions, so as to ensure especially;

- a) Personal safety against electric shock
- b) Personal safety against effects of excessive temperature
- c) Safety against spread of fire
- d) Protection against penetration of solid objects, dust and water.

All parts which are subject to corrosion shall be suitably protected and any protective coating shall not be liable to damage by normal handling.

9.3.4.1 Case and Window

The Meter shall have an insulated case which shall be sealed in such a way that the internal parts of the meter are not accessible to unauthorized persons such that double insulation for the meter is ensured.

Any non-permanent deformation of the case shall not affect the satisfactory performance of the meter.

The window shall be of transparent material which cannot be removed without damaging the window or breaking seals.

9.3.4.2 Terminal Block

The terminal block shall be made of insulating material and it shall be capable of passing the test stipulated in ISO 75-2:2013 for a temperature of 135°C and a pressure of 1.8 MPa.

Each terminal shall have two screws for effectively clamping two numbers 2.5mm² copper cables and the bore of the terminals shall be adequate enough to accommodate two numbers 2.5mm² copper cables. It shall be made of tin/nickle plated brass/copper.

9.3.4.3 Terminal Cover

The wiring terminals shall be protected by a sealable terminal cover and the terminal cover shall be made of an insulating material.

The terminal covers shall be of extended type with easily breakable knockouts. Provision shall be made to seal the meter cover and terminal cover separately.

9.3.4.4 Resistance to Heat and Fire

The terminal block, the terminal cover and the meter case shall not ignite by thermic overload of live parts in contact with them and they shall meet the tests stipulated in Clause 5.8 of IEC 62052-11

9.3.4.5 Protection Against Penetration of Dust and Water

The Metering equipment shall be suitable for indoor use and conform to the degree of protection of IP51 as per IEC 60529.

9.3.4.6 Display of Measured Values

The Meter shall be provided with a LED Display under a viewing panel conforming to the degree of protection of IP 65 and the dimensions of figures shall not be less than 4 mm (Height) and 4mm (Width). Minimum number of digits shall be 10 including the decimal point and shall be capable of showing three decimal points in a particular reading.

9.3.4.7 Output Device

The Meter shall have a test output device (outlet port) accessible from the front and capable of being tested with the help of the universal reference standard meter.

9.3.5 CLIMATE CONDITION

9.3.5.1 Temperature Range

The operating Temperature range of the Meters shall conform to the table 5 of IEC 62052-11 for indoor meters.

9.3.5.2 Relative Humidity

The meters shall be suitable for indoor operation in a humid tropical climatic condition with the maximum relative humidity of 90%

9.3.6 INFLUENCE OF HEATING

The temperature rise at any point of the external surface of the meter shall not exceed 25K with the ambient temperature at 40°C. Under normal operating condition the electrical circuits and insulation shall not reach a temperature which might affect the operation of the meter

9.3.7 ELECTROMAGNETIC COMPATIBILITY

a) Immunity to Electromagnetic Disturbance

The Meters shall be designed in such a way that conducted or radiated electromagnetic disturbance as well as electrostatic discharge do not damage or influence the meter.

b) Radio Interference Suppression

The Meters shall not generate, conduct or radiate noise which could interfere with other equipment.

9.3.8 ACCURACY REQUIREMENTS

a) Starting and Running with No-Load

The Meter shall be fully functional within 5 seconds after the voltage is applied to the meter terminals.

When the voltage is applied with no current flowing in the current circuit the test output of the meter shall not produce more than one pulse. The meter shall start and continue to register at 0.001 of basic current.

b) Meter Constant

Sufficient pulse rate (meter constant) shall be generated at low load condition (1/10 of CT ratio). The relation between the test output and the indication in the display shall comply with the marking on the name plate.

9.3.9 MARKING OF METERS

a) Every meter shall be indelibly marked with a diagram of connections and this diagram shall also show the sequence for which the meter is intended, preferably inside the meter terminal cover.

b) The Name Plate of Meters shall bear all the information stipulated in clause 5.12 of IEC 62052-11. The marking shall be indelible, distinct and readable from outside the meter.

- c) The words “Property of the Ceylon Electricity Board (CEB) with a mark “Warranty 5Y “shall be engraved on the nameplate.
- d) Serial number (which will be indicated at the time of placing an order) shall also be engraved on the nameplate.

9.4 QUALITY ASSURANCE

The manufacturer shall possess ISO 9001 Quality Assurance Certification for the design, manufacture and testing of Programmable Static Poly phase Energy Meters. In the event the meters are manufactured in a plant under the licensed of the manufacturer, the manufacturing plant shall possess ISO 9001 Quality Assurance Certificate for manufacturing and testing of Three Phase Energy Meters. The Bidder shall furnish a copy of the ISO Certificate certified as true copy of the original from the manufacturers, along with the offer.

Each Meter to be tested and calibrated at a meter testing laboratory having ISO/IEC: 17025:2015 and properly sealed with security synthetic seal with identification numbers. Test report shall be dispatched to the purchaser before inspection.

The proof documents with regard to the accreditation for the above facility in accordance with ISO/IEC: 17025:2005 shall be submitted along with the bid.

9.5 TESTING, INSTALLATION AND COMMISSIONING

9.5.1 TYPE TEST

The following Type Test Certificates conforming to IEC 62052-11 shall be furnished with the offer.

- i) Test of insulating properties
 - a) Impulse test voltage
 - b) A.C. Voltage Test
- ii) Test of Accuracy requirements
 - a) Test of meter constant
 - b) Test of starting condition
 - c) Test of no-load condition
 - d) Test of influence quantities
- iii) Test of electrical requirements
 - a) Test of power consumption
 - b) Test of influence of supply voltage
 - c) Test of influence of short-time current
 - d) Test of influence of self-heating
 - e) Test of influence of heating
 - f) Test of immunity to earth fault
- iv) Test of electromagnetic compatibility
 - a) Radio interference suppression
 - b) Fast transient burst test
 - c) Damped oscillatory waves immunity test
 - d) Test of immunity to electromagnetic RF fields
 - e) Test of immunity to conducted disturbances, induced by radio-frequency fields
 - f) Test of immunity to electrostatic discharges.
 - g) Surge immunity test

- v) Tests of the effect of the climatic environments
 - a) Dry heat test
 - b) Cold test
 - c) Damp heat cyclic test
 - d) Solar radiation test

- vi) Mechanical Tests
 - a) Vibration Test
 - b) Shock test
 - c) Spring Hammer Test
 - d) Tests of protection against penetration of dust and water
 - e) Test of resistance to heat and fire

The Type Test Certificates shall clearly indicate the following;

- a) Name, Address and Country of the Testing Authority
- a) Date of Testing
- b) Name of Equipment Type Tested
- c) Number of pages of the Type Test certificates
- d) Manufacturers identity/Catalogue Reference Number etc.
- e) Basic Parameters
- f) The Standard to which the equipment Type tested.
- g) Comments and Observations of the Testing Authority

The Type Test shall be performed at a reference voltage of 110V/400V at a reference frequency of 50Hz.

Type Test Certificates shall be from an accredited independent testing laboratory acceptable to the CEB complying to ISO/IEC 17025. Proof of accreditation by a national/international authority shall be forwarded with the offer. Test reports shall be complete including all the pages as issued by the testing authority. Type test reports shall be in English language. Parts of test reports shall not be acceptable.

9.5.2 ACCEPTANCE/SAMPLE TEST

Following tests shall be carried out conforming to IEC 62052 – 11, IEC 62053-22, IEC 62053-23 and IEC 62058-31 under the witness of;

- An independent testing authority acceptable to CEB : If the scope covers supply delivery and installation of meters or
- An Engineer is appointed by CEB : If the scope is limited to supply and delivery of meters (Refer clause 8.2 of this specification)

- a) Preliminary tests and pre-conditioning

Meters shall be visually examined for none shown signs of damage and their specified marking are correct. The meter shall be energized at reference voltage and $0.1I_b$ at unity power factor for at least 30 min to verify that the rotors turn and to pre-condition the meters.

- b) Test of insulation properties
 - i) A.C. Voltage Test

- c) Tests of Accuracy requirements
 - i) Test of Meter Constant
 - ii) Test of Starting condition

- iii) Test of No-load condition
- iv) Limits of error due to variation of current
- v) Limits of error due to influence qualities (voltage variation, voltage unbalance, harmonics in voltage and current, external magnetic fields).

Extra copies of the acceptance test report shall also be supplied with the meters.

9.5.3 INSTALLATION AND COMMISSIONING (Not applicable in case the Scope of supplier is limited to Supply and Delivery of Goods)

9.5.3.1 Meter Panel

All panels shall be constructed or braced rolled steel section, with recessed panels and substantial mounting sheets for power and control cable work. All steelwork shall be constructed of steel sheets with a minimum thickness of 2mm. The minimum width, depth and height of all cubicles shall be 800 mm, 800mm and 2200 mm respectively.

The interior of each cubicle shall be finished with a mat light coloured surface and an interior lamp suitable for local LVAC supply and controlled by a door-operating switch and fitted at the top of each cubicle. Anti-condensation heaters shall also be fitted in each cubicle and each cubicle shall be well ventilated top and bottom through vermin proof louvers fitted with brass gauze screens. Each protection cubicle shall also be equipped with a built in AC supply socket outlet of single phase. Three wire rated 13 A at 230 V, 50 Hz.

The cubicle shall be of the self-standing, floor-mounted type and shall be provided with ways and means for floor fixing and anchoring devices. They shall be supplied completely with their fixing and lifting racks and eyebolts. Equipment and terminals shall be readily accessible and shall require a minimum of disturbance of associated adjacent equipment for access. The arrangement of panel wiring and multicore cable terminal boards shall be in accordance with the relevant clauses of Chapter 3 of this Specification.

Enclosures shall be provided for bottom entry of power and multi core cables via gland plates. Removable gland plates shall be located within the cubicles so as to provide adequate working clearance for terminating the cables.

Where any sensitive equipment are mounted on hinged front panels, these shall be designed to minimize shock and wiring shall be so arranged as to impose no strain on terminations. No equipment whatsoever shall be mounted on rear access doors.

All sections of a composite cubicle shall be suitably labelled in accordance with the specification and labels at the rear shall also readily identify each section or panel with the access doors either opens or close.

Each panel shall be of the swing rack type including 19" swing frame and a front cover door equipped with a glass window and each control panel shall be of the enclosed type.

The indoor meter panel shall be of at least IP 41 protection class. Each door shall be fitted with suitable earth straps of at least 16 mm² highly flexible stranded copper wire with an insulation in green-yellow colour.

Doors are to be arranged so that every individual door or frame can be opened without moving doors of adjacent cubicles. Doors shall be of 2mm thick sheet steel, equipped with 120° concealed hinges, with foamed-in seal and shall be provided with a stable, bolted, rectangular tube frame, with pre-punched holes at 25 mm pitch for fixing channels, covers, cable harnesses, wiring plan pockets and etc. The door stopper at the end of the throw shall be provided. Doors shall be handled by smooth action locking bars with rollers and security lock system, prepared for insert lengths of 40 or 50 mm. The insert shall be provided in accordance with the master key system of Employer, for which details shall be forwarded to the contractor on request.

The contractor shall perform a calculation for the heat dissipation for enclosures with the maximum installed heat-losses and shall propose a suitable temperature control method. However the method has to be approved by the Engineer.

Panels and cabinets are to be installed in totally air-conditioned control rooms. Cubicles provided as extensions or for erection in the same room with existing cubicles shall be of similar appearance. All enclosures and accessories such as swing frames shall be corrosion protected by electrophoresis-dip-coat primers and final coats by an approved procedure as to suit the surrounding conditions at site.

The arrangement and mounting of meters and all other devices shall be to the approval of the Engineer. The exterior and interior finish and colour of all cubicles shall be to the approval of the Engineer.

9.5.3.2 Cabling and Wiring

In selecting cable and wire sizes, due regard shall be paid to the appropriate de-rating factors in relation to the climate conditions at site. All cables and wires shall continuously carry their rated currents under the worst temperature conditions and shall also withstand maximum fault currents without damage or deterioration.

All secondary copper wiring within panels, racks, boards, etc. shall be in accordance with the pertaining IEC, it shall be carried out for the fully rated distribution voltage (2 kV AC/ 1 min. test voltage) and shall consist of copper wires. The bare ends of stranded wires shall be provided with squeezed sleeves.

The minimum Cross-section of each copper wire shall be at least as specified in the chapter 3 of this specification. Wiring shall be neatly run in PVC rigid plastic wire-ways, clear of any metal panels and filled not more than 70% or bundles with no bunch containing more than 12 wires. All power and control cables used for less than 60 V DC shall be laid and terminated separately. Where power and control cables cannot be laid separately, suitable metallic barriers shall be provided.

Both ends of every wire core and all secondary panel wiring above 60 V (at the screwed terminal side for external connection as well as at the screwed device sides in the panel) shall be fitted with numbered slip-on ferrules of moisture and oil-resisting insulation material having a glossy finish, and with their identification numbers clearly engraved, each being the same as for the relevant terminal.

Ferrules of white colour with black letters, shall be fitted in such a way that they cannot become detached when the wire is removed from the terminal. (i.e. end crimps shall be provided).

All secondary wiring to be performed at site shall enter the terminal block at one side only. The panel wiring shall terminate in one or more terminal blocks accommodated at the side or bottom of each panel. Internal wiring between meters shall be permitted within the same cubicle only.

Cables with spiral wrap designed shield shall be used for the current transformer circuits and voltage transformer circuits. The shield shall be grounded at both ends of the cable. Generally, for wiring, the

cable tails shall be so bound that each wire may be tracked back to its associated cable without difficulty. Cores in pairs or groups shall be terminated together.

All incoming control cables shall contain minimum 20% spare cores and be connected to terminal blocks, with 20% spare terminals of each type. Any further spare cores shall be numbered included in the list of cable table and shall be sealed in further spare terminals.

9.5.3.3 Terminal blocks

Terminal block shall be numbered consecutively in both sides, preferably beginning with 1, from left to right or top to bottom. Terminal blocks shall consist of single "insertion" type terminals of non-tracking, non-inflammable synthetic plastic, or ceramic of an approved type, lined up in one row. Polyamide terminal blocks are not acceptable. All terminals shall have two separate pressure clamping plates suitable for connection of incoming or outgoing stranded or solid conductors, respectively. However, only one wire per terminal will be accepted. Terminals with clamping screws in direct contact with the conductor are not acceptable.

The following minimum categories of terminals shall be used:

- Terminals for power circuits of 6 mm² and 2.5 mm² size
- Current transformer secondary terminal shall be 4 mm² size and shall have :
 - Facility to short circuit the current transformer side
 - Facility to isolate the current transformer secondary side and relay side by opening link in each terminal
 - Facility to directly plug in probes from test kit without removing wires from the terminal block
- Voltage Transformer Secondary terminals shall be 4 mm² size and shall have
 - Facility to isolate the voltage transformer secondary side by opening link in each terminal
 - Facility to directly plug in probes from test kit without removing wires from the terminal block
- DC circuit: It shall be possible to isolate the internal and external wiring using "knife disconnection" mechanism
- Terminals for wiring of 1.5 mm² and 0.6 mm² size with bridging facilities to the neighbouring terminals.

Insulating barriers shall be provided between each group of power circuit terminal categories, the height and the spacing begin such as to give adequate protection to terminals. Current and voltage transformer secondary circuits, battery and auxiliary power supply wiring, supervisory, alarm and communication circuits shall be protected against conductive, electrostatic and electromagnetic influences.

9.5.3.4 Meter Installation

- a) Contractor shall perform visual inspection to ensure that there is no damage resulting from shipment. Contractor shall install meters in accordance with the drawings and manufacturer's instructions. Any damaged paintwork shall be touched up.
- b) Meters should be programmed by the contractor for the settings specified in this specification and for any other variations requested at the time of installation.
- c) Terminals and connecting cables from voltage transformers, and current transformers up to and including the meter (including any and all terminations between voltage/current transformers and the meter) shall be made inaccessible by a sealed cover, complete with an approved seal. Furthermore, meters shall be sealed with an approved seal.

- d) Energy meters shall be supplied from dedicated VT windings and CT cores. No other loads shall be connected to these windings/cores.
- e) Energy meters shall be installed on a dedicated panel in the existing station relay room.
- f) Contractor should perform an accuracy measurement test and check the CT and VT ratios using secondary injection methodology or any other means to the satisfaction of the Engineer.
- g) Technical literature in English language on the installation, calibration and maintenance shall be supplied with each set of meters and they shall be descriptive and self-explanatory, complete with necessary connection diagrams and drawings
- h) The Contractor shall prove to the satisfaction of the Engineer and the Owner, that the metering system and remote access to the meter system is functional, in all regards.

9.5.3.5 Establishing Remote Communication

Remote communication with meters shall be successfully implemented under following two methods.

a) GSM/ GPRS based wireless communication

Install GSM/GPRS modem and all accessories at the meter end and establishing GSM/GPRS based remote communication between meters and modem connected to the PC on which the meter Software is installed at Energy Marketing branch Meter Data Downloading Centre.

b) CEB communication network based wired communication

Energy meters in DISCO panel shall be linked to the network switch install at the same panel while energy meters in TRANSCO panel shall be connected to the network switch in that panel. Two switches shall be connected to two separate Ethernet ports in the fiber optic multiplexer using Ethernet cable (of type UTP, CAT 6) laid through a PVC insulated GI spiral conduit. The necessary surge protectors for the Ethernet cable shall also be installed at the multiplexer end. The required configurations on the CEB communication network shall be carried out by CEB and remote connection between energy meters and the Energy Marketing branch Meter Data Downloading Centre shall be tested by the contractor.