SECTION – 2.20

TARIFF (SEM's) METERING SYSTEM

1.0.0 INTRODUCTION

This section covers the requirements of tariff/ Revenue Metering / Special Energy Meters / ABT (Viability Based Tariff) metering system associated with 132 kV system (GIPCL and GSS end) and associated auxiliary system at GIPCL end.

2.0.0 SCOPE OF WORK

2.1.0 The scope of work shall include the following equipment.

- Metering system broadly including but not limited to following
  - Special Energy Meters with required communication ports.
  - Automated Metering system (AMR) with software.
  - Modem complete with antenna, power supply adaptors and its connection / communication cords and associated OEM supplied accessories. Required SIM cards will be free supply by the owner.
  - Temper proof Panels / Cubicles complete with TTB's, internal wiring etc.
  - CMRI (Common Meter Reading Instrument) with software and accessories.
  - BCS – Base computer software.
- 132 kV Metering system of transmission line may have meters up to 8 Number of metering system as mentioned below,
  - Two (02) Number for Line-3 at GIPCL end,
  - Two (02) Number for Line-4 at GIPCL end.
  - Two (02) Number for Line-3 at GETCO/STU/ GSS end.
  - Two (02) Number for Line-4 at GETCO/STU/ GSS end.

  However as per CEA Regulation on "Installation and Operation of Meters" Regulations 2010 amended time to time EPC contractor shall finalize the scheme with concerned competent authorities (SLDC, GETCO, STU, DISCOM etc.). Number of metering system and its locations shall be as per the approval given by the competent authority
- Metering system for Balance of Plant Auxiliary system
  - One (01) Number of Metering system at 11 kV Panel of Auxiliary transformer at MCR.
  - One (01) Number of Metering system at 415 V side of Auxiliary transformer at MCR.
- Metering system for BESS Plant auxiliary system shall be provided as per system requirement if any / as applicable.

2.2.0 SEM's may be sourced from GETCO/STU/DISCOM, subject to their timely allotment. In case timely allotment is not feasible, Secure make APEX-150 meters, complete with all required hardware and suitable flush mounting installation kits, shall be supplied by the bidder.

2.3.0 ABT Meter shall be manufactured with specific Serial Numbers allotted by Concerned Authority (GETCO/SLDC/DISOCM etc.). Serial numbers for meters are to be obtained by EPC contractor form the concern authorities and communicated to OEM before commencement of manufacturing.

2.4.0 Approval and liaisoning with concern competent authorities and required charges (supply , laboratory testing, approval of metering scheme, allotment of serial numbers, site testing etc.) is in solely in scope of bidder.

2.5.0 Detail specification of the Metering system shall be as per requirement concern competent authority (GECO / STU / DISCOM etc.).

2.6.0 All software and associated licenses shall be provided on a perpetual basis, with no recurring or subscription-based costs to the Owner.

3.0.0 CODES, STANDARDS, CEA/POSOCO Guidelines, Reports and technical specifications

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest version of the relevant IS / IEC standards, CEA metering regulations and CBIP publications including amendments, if any, except where modified and / or supplemented by this specification. Some of the applicable standards and publications are listed below:

a) IS 14697 : Specification for AC static transformer operated watt-hour and var-hour meters, Class 0.2S and 0.5S

b) CBIP Technical Report – 88 : Specification for AC static electrical energy meters

c) CBIP Technical Report – 111 : Specification for common meter reading instrument

d) IS 9000 : Basic environmental testing procedures for electronic & electrical items

e) IS/IEC 60529 : Degrees of protection provided by enclosures

f) IEC 62053-61 : Electricity metering equipment (A.C.)

g) CEA Installation and Operation of meters Regulations 2006, 2010, 2014, 2019 and Draft for 4th amendment.

h) CEA Report on SAMAST (**S**cheduling, **A**ccounting, **M**etering **A**nd **S**ettlement of **T**ransaction) in Electricity -July 2016

i) POSOCO, Technical Specification for Interface Energy Meters, Automated Meter Reading System and Meter Data Processing for Inter State System in Western Region as approved in 34th TCC/WRPC meeting held on 28 July 2017.

j) Guidelines on Cyber Security in Power Sector 2021-1, Dated 7-10-2021.

4.0.0 TECHNICAL REQUIREMENTS

4.1.0 General

4.1.1 Tariff metering systems shall meet the requirements of GETCO, STU, SLDC, DISCOM and similar other concerned competent statutory authorities.

4.1.2 Tariff metering panel for 132 kV system shall be installed in the common metering panel and shall be located in MCR C&R room or as approved by the competent statutory authority.

4.1.3 The panel shall be made of cold rolled sheet steel of thickness not less than 2mm. The panel shall be of double door with front toughened glass. Degree of protection shall be at least IP 54. The panel shall be complete with door limit switch operated cubicle lighting, 5A switched power socket, hygrostat-controlled space heater, terminal block, panel earth bus, body earth pads, temper proof sealing arrangements etc.

4.1.4 All wiring shall be carried out with 1100V grade stranded 1.5 sq. mm copper conductor wires with PVC insulation. For current transformer (CT) and voltage transformer (VT) circuits 2.5 sq. mm copper conductor wire with PVC insulation shall be used. Wiring shall be color coded.

4.1.5 Terminal blocks shall be clip-on type 600V grade, 10A rated stud type terminals with markings. Terminals for VT secondary leads shall be stud, disconnecting type. CT secondary leads shall be provided with short circuiting and earthing facility. At least 20% spare terminals shall be provided for each terminal station and each type of TB. CT / VT test terminals shall be provided separately.

4.1.6 The energy meters shall provision for time synchronization with master clock by NTP/SNTP protocol. Necessary hardware and software shall be provided for the same.

4.1.7 The accuracy class of SEM's shall be of 0.2s class .

4.1.8 The accuracy class of current transformers (CTs) shall be 0.2s class and voltage transformers (VTs) shall be 0.2 class.

4.1.9 The meter shall be immune to external influences like magnetic induction, vibration, electrostatic discharge, switching transients, surge voltages, oblique suspension, and harmonics and necessary tests shall be carried out in accordance with relevant standard.

4.1.10 The meters shall safely withstand the usual fluctuations arising during faults etc. as per IS 14697. The immunity to external magnetic field shall be strictly as per latest CBIP recommendations.

4.1.11 Lead cables of CTs and VTs shall be of sufficient cross-section for reducing voltage drop to minimum between end connections (connection between cable lead end and CT / VT terminal as well as between cable lead end and meter terminal). No joints and or intermediate junction boxes (lead wires from instrument transformer secondary terminal box shall be directly terminated to metering panel) shall be allowed in lead cables. The burden on metering cores of CTs and VTs including burden of lead cable and meters connected there to shall not exceed rated burden. The CT wiring shall be of 6 wire type (i.e. Not 4 wire type)

4.1.12 ABT metering system shall be compliant to CEA Guidelines on Cyber Security in Power Sector 2021-1, Dated 7-10-2021.

4.2.0 Functional Requirements

4.2.1 The meter must perform four quadrant measurements. The interface meters suitable for ABT shall be static type, composite meters, as self-contained devices for measurement of active and reactive energy, and certain other parameters as described. The meters shall be suitable for being connected directly to VTs having a rated secondary line-to-line voltage of 110V and to CTs having rated secondary current. The reference frequency shall be 50Hz.

4.2.2 The active energy (watt-hour) measurement shall be carried out on 3-phase 4-wire principle with accuracy as per class 0.2s of IEC-687 / IEC-62053-22. The VAR and reactive energy measurement shall also be on 3 phase 4 wire principle with accuracy as per class 0.2 of IEC 62053-22 or better.

4.2.3 The meter shall be compatible with time of the day (TOD) tariff. For TOD tariff, meter shall have the provision to define maximum eight (8) TOD registers for different energies.

4.2.4 The meter shall continuously monitor and calculate the average demand in KVA during the integration period and maximum out of these shall be stored along with date and time in the meter's memory. The integration period shall be site programmable for 5/15/30/60 minutes or as per regulatory requirements on real time basis on block / sliding window principle that shall also be programmable. The meter shall also display maximum demand (MD) reset count. The MD. resetting shall be possible in any of the following ways:

a) Automatic reset on a predetermined date and time of the month
b) Resetting through a hand held terminal or computer capable of communicating with the meter with password protection

4.2.5 Meters shall be suitable for working under balanced / unbalanced loads at all power factor as specified in the relevant IS. The display shall indicate direct values without having to apply any multiplying factor.

4.2.6 The meter shall also store the apparent energy (import and export) and cumulative energy. Registers of the same shall be made available on display as well as Base Computer Software (BCS).

4.2.7 There shall be provision for self-check and diagnosis at regular intervals. The meter shall have indication for unsatisfactory functioning of the following:

- Time and calendar
- Real time clock battery
- All display parameters
- Non-volatile memory

4.2.8 There shall be programmable facility to restrict access with three level passwords.

4.2.9 On any programme change, the meter shall reset itself to zero and the previous information shall be stored in the non-volatile memory.

4.2.10 There shall be provision for access to the meter by a computer (desktop, PC or laptop) and remote reading or data storage via communication system.

4.2.11 The meter shall log the time and date of all programme changes in a billing period.

4.2.12 The metering system shall be compatible with suitable BCS.

4.2.13 The meters shall have following minimum facilities:

a) Communication port: Two RS 485, RS 232 & front optical port and all communication ports of meter shall be available for simultaneous uninterrupted communication.
b) Load survey capability
c) Missing potential indication in case of failure of potential at the meter incoming terminal.
d) Provision for telemetering using common protocol
e) Provision for collection of data by meter reading instrument (MRI)
f) Provision for time synchronizing facility from external clock. Provision for correcting real time by MRI
g) Sliding integration window/block integration
h) Real time clock
b) Non-volatile memory for 35 days
c) Test output device in the form of a pulse indicator accessible from the front and capable of being monitored by suitable testing equipment
d) CT/VT error compensation

4.2.14 Transformers / transducers required for their functioning shall be in-built in the meters. Necessary isolation and / or suppression shall also be built-in for protecting the meters from surges and voltage spikes that occur in the VT and CT circuits of extra high voltage Substations.

4.2.15 The active energy (watt-hour) meter shall display on demand the export / import energy during programmed integration block (As per prevailing regulation 15 min).

4.2.16 Further the meter shall continuously integrate and display on demand the export / import cumulative active energy sent out / in from / to the substation bus bars up to that time in export and import register. The cumulative energy reading at each midnight shall be stored in the meter memory in respective registers. There shall be separate register for export and import.

4.2.17 The meter shall count the number of cycles in VT output during each successive 15 minutes block and divide the same by 900 to arrive at the average frequency (truncated to second place of decimal). This shall be stored in the meter's memory. The average frequency of the previous programmed integration period (As per prevailing regulation 15 min) shall also be displayed on demand in hertz.

4.2.18 The meter shall continuously compute the average of the root mean square (RMS) values of the three line to neutral VT secondary voltage as a percentage of 63.51V and display the same on demand.

4.2.19 The reactive energy (VARh) meter shall store the values in different registers as below:

- Above 103% voltage: reactive energy import & export
- Below 97% voltage: reactive energy import & export
- Reactive energy import with active energy import
- Reactive energy import with active energy export

4.2.20 Each meter shall have a test output device (visual) for checking the accuracy of active energy (watt-hour) measurement. The preferred pulsing rate is twenty and four per watt-hour for 1A and 5A CT respectively. It shall be possible to couple this device to suitable testing equipment also.

4.2.21 The accuracy of the meter shall not be affected by harmonics circulating in the system of magnitudes within permissible limits stipulated by CEA Grid Standards and Regulations. The meter shall indicate and record the total resultant quantities of fundamental frequency and harmonics or alternatively the meter shall record fundamental frequency quantities and harmonics related quantities (such as MWh, MVAh and MVARh) separately. Only fundamental frequency values shall be used for billing purpose.

4.2.22 The meters shall normally operate with auxiliary power and shall have an automatic change over system to draw power from the VT secondary circuits in the case of failure of auxiliary power. The total burden imposed by a meter for measurement and operation shall not exceed 10VA on any of the phases. An automatic back up to continue operation of the meter's calendar clock, and for retaining all data in its memory, shall be provided through a long life battery, which shall be capable of supplying the required power for at least two years. The meters shall be supplied duly fitted with the batteries, which shall not require to be changed for at least 10 years, as long as total VT supply interruption does not exceed two years. The meters shall not require any separate auxiliary supply for their operation. All displays may disappear on loss of VT supply.

4.2.23 Each meter shall have a built-in calendar and clock having an accuracy of one minute per year or better. The calendar and clock shall be correctly set at the manufacturer's works. The date (day-month-year) and time (hour-min-sec) shall be displayed on the meter front (when VT supply has been connected), on demand. Only limited clock adjustment shall be possible at site, using the data collection device (DCD). When an advance or retard command is given,

six subsequent time blocks shall be contracted or elongated by ten seconds each. The meter shall not accept another clock correction command for seven days. All clock correction shall be registered in the meter's memory and suitably shown on print out of collected data.

4.2.24 Each meter shall have a unique identification code, which shall be marked permanently on its front, as well as in its memory.

4.2.25 Each meter shall have at least one nine (9) character, nine-segment electronic display, for indication of the various parameters (one at a time), on demand.

4.2.26 A touch key or push button shall be provided on the meter front for switching on the display and or changing from one indication to the next. The display shall switch off automatically about one minute after the last operation of touch key / push button. When the display is switched on, the parameter last displayed shall be displayed again, duly updated.

4.2.27 The three line-to-neutral voltages shall be continuously monitored, and in case any of these falls below 70%, the condition shall be suitably indicated and recorded.

4.2.28 Each meter shall have an optical port on its front for tapping all data stores in its memory. Portable or hand held data collection devices shall also be separately provided for this purpose, to serve as the interface between the meters specified above and the local personal computer (PC). The overall intention is to tap the data stored in the meter's memories once in a month and transmit the same to a Substation automation system / Main control station using communication links, through the local PC. It shall also be possible to obtain a print out (hard copy) of all data collected from the meters using the local PC.

4.2.29 The whole system shall be such as to provide a print out (both from the local PC, and from Substation automation system / Main control station) in an easily understandable / self-explanatory format.

4.2.30 All meters of the same model shall be totally identical in all respects except for their unique identification codes. They shall also be totally sealed and tamper-proof, with no possibility of any adjustment at site, except for clock correction.

4.2.31 The meters shall also withstand without any damage any mal-operation, reasonable mechanical shocks, earthquake forces, ambient temperature variations from –20°C to 55°C, relative humidity etc. They shall have an IP 51 category dust tight construction, and shall be capable of satisfactory operation in an indoor, non-air conditioned installation.

4.2.32 Portable / hand-held data collection devices (DCD) shall be tailor-made for tapping all data stored in a meter's memory and faithfully transferring it to the local PC. Each device shall at least comprise of the following:

- A lead with optical head for coupling it to the meter
- A lead for plugging it to a personal computer
- A internal battery for powering the devices
- A case for safely carrying it about
- A battery charger

The total arrangement shall be such that one (1) operator can carry out the whole operation himself, in a quick and reliable manner.

4.2.33 The meters shall continue to function, as specified above, in case of failure of one or two phases of VT supply. In case of a complete supply failure, the computation of average frequency shall be done only for the period during which the VT supply was available in the programmed integration period (As per prevailing regulation). Any time block contraction or elongation for clock correction shall also be duly accounted for.

4.2.34 Load Survey Capability:-

(a) It shall be possible to store previous minimum 35 days data regarding energy consumed (programmed integration period (As per prevailing regulation 15 min) minutes blocks), demand and frequency. That is load survey is needed for the demand and energy consumed in every MD integration time cycle (programmed integration period (As per prevailing regulation)). The demand to be recorded in the load survey shall match with the recorded in DISPLAY PARAMETERS. The demand and energy consumed as discussed shall be recorded separately under energy import / energy export within a programmed integration period (As per prevailing regulation) minutes time block. It shall be possible to down load and view parameters and load survey data on computers and obtain full details of demand and consumption in statement form and also in graphic form.

(b) Necessary software for various programmable features to obtain various details shall be provided by the supplier. The software shall include provision for load survey graphic presentation and other reports generation in BCS from the data collected from the meter through meter reading instruments

4.2.35 Each of the metering system shall measure and display on demand the following quantities / parameters on demand:

i) Meter Serial No.
ii) LCD segment check
iii) Real Time: HR:MT
iv) Date dd/mm/yy
v) Rising Demand in kVA
vi) Maximum demand in kW and kVA (export / import)
vii) Cumulative active energy import
viii) Cumulative apparent energy import (kVAh)
ix) Last 15 minutes block average of the active power / load import
x) Cumulative active energy export
xi) Cumulative apparent energy export (kVAh)
xii) Last 15 minutes block average of the active power / load export
xiii) Instantaneous three phase average power factor with sign / display / legend for lag / lead.
xiv) Instantaneous Phase Voltage (R Phase , Y Phase & B Phase)
xv) Instantaneous Line Currents (R Phase , Y Phase & B Phase)
xvi) Instantaneous Frequency
xvii) Phase Sequence of voltages
xviii) Instantaneous Active Load in
xix) Instantaneous Reactive Load in WVAR
xx) Cumulative VARh injection when, average voltage(RMS)>103%Vn
xxi) Cumulative VARh drawal when ,average voltage(RMS)>103%Vn
xxii) Cumulative VARh injection when, average voltage(RMS) < 97%Vn
xxiii) Cumulative VARh drawal when , average voltage(RMS) < 97%Vn
xxiv) Cumulative VARh (lag), when watt-hour is import
xxv) Cumulative VARh (lead), when watt-hour is import
xxvi) Cumulative VARh (lag), when watt-hour is export
xxvii) Cumulative VARh (lead), when watt-hour is export

A key pad shall be provided on the meter front for switching on the display and for changing from one indication to the next.

4.2.36 ABT meters shall have minimum 10 years of Guarantee directly to the purchaser / GIPCL.

4.2.37 EPC contactor shall finalize the scope of supply of Metering system STU / GETCO / DICOM / SLDC etc. If scope of supply is of STU / GETCO, then metering panel shall be proposed and designed suitably to accept meters supplied by STU / GETCO. (It may be noted that even if

scope of supply is of STU / GETCO, required charges , cost etc. is to be borne by EPC contractor)

4.2.38 ABT Meter Software shall be compatible with MDP software's of concerned authorities and "dummy data file" of each ABT meter is to be furnished well in advance as a part of first time charging (FTC) compliance. EPC contractor shall line up this with the OEM of the meter at ordering stage.

4.2.39 Each ABT meters shall be provided with AMR faculty (Automated Meter Reading or Remote Metering) with GPS and GPRS Modem, along with its supply adaptor and antenna, software's/ driver etc. Required SIM card of the meters will be free supply form the owner.

4.2.40 Meter panel shall have provision of dedicated 230 V UPS supply for each metering system for future requirements. UPS supply shall have separate MCB with signaling contact integrated to SCADA/SAS/EnMS.

4.2.41 Auxiliary supply of each ABT Meter shall be from two sources (110 V DC Main-1 and 110 V DC-Main-2) with selection scheme / Diode type "O Ring units". Each meter shall have dedicated MCB with it's trip status monitoring at SCADA as well as at local annunciator.

4.2.42 Auxiliary supply systems of ABT meters are to be monitored (NO Volt relay) in SAS / SCADA and local annunciator.

4.2.43 Each ABT meter shall have separate / dedicated TTB and shall be connected in such a way that it facilitates testing / checking / removal / replacement activates without affecting other ABT meter connected to same core of CT/PT. TTB shall be of 3 phase-4 wire type. TTB shall be mounted below the meter and in front of the panel. Rear side of TTB shall have tamperproof sealing arrangement. TTB shall be of large size and shall be of SCREW type (e.g. Dev industries model no 4SF)

4.2.44 CMRI shall be provided with required software, optical probe, communication cable, data cable, carrying case shall be provided. (At two numbers of CMRI to be provided for each Substation)

4.2.45 Two nos. of Laptop (HP / DELL make) with required BCS software, probes, cable and all required accessories to be provided for downloading, configuration and time drift correction of ABT Meters shall be provided.

4.2.46 In case, time drift correction of more than 1 minute is required, Meter OEM shall extend this facility to GIPCL for the period of three years from the date of commissioning of the meters without any cost to GIPCL. Same shall be given in writing to GIPCL by OEM of the meter.

4.2.47 Indication circuit of Tariff metering panel is to be protected with dedicated MCB's.

4.2.48 For tariff metering instrument transformers (CT/PT), shall have separate / dedicated terminal box shall be provided with temper proof sealing arrangements.

4.2.49 All ABT meters and all CT/PT's of tariff metering system are to be tested at approved NABL (Third party other than OEM) accredited laboratory in presence of GETCO/ STU/DISCOM and owners representative at appropriate stage without any cost to GIPCL. (Travelling, lodging boarding charges for GIPCL representative will be borne by GIPCL)

4.2.50 4 Nos of ABT meters, duly tested at NABL lab, with specific serial numbers allotted by concerned authorities shall be supplied for future use along with 4 nos. of Modems.

4.2.51 Site testing and sealing of metering system (ABT meters and CT/PT's, TTB's, Terminal boxes, Panel doors etc.) by concerned authorizes and applicable charges, as applicable, is in scope of EPC Contractors.

4.2.52 Comprehensive memory mapping and documentation (User manual, testing and commissioning manual etc.) of ABT meters to be provided.

4.2.53 Required software, equipment's with all accessories for ABT Meter configuration at site shall be provided.

4.2.54 All software's and Meters permanent passkeys (Pass Words) of all level shall be provided.

4.2.55 ABT meters shall compatible for future regulatory requirements (e.g. Time Block from 15 minute to 05 minute etc.)

4.2.56 Instrument transformers burden, ratio, number of tapings , CT secondary amp (1A or 5A) and instrument safety factor (ISF) shall be proposed by EPC contractor in consultation and approval with concerned authorities at detail engineering stage.

4.2.57 Indication circuit of Tariff metering panel is to be protected with dedicated MCB's.

4.2.58 ABT meters shall be flush mounting (panel mounting) type (with or without external hardware kit) are preferred or wall / projection mounting. In case projection mounted / wall mounted type meters are used than the metering panel and mounting of the meter requires special consideration and design.

- Wires to Meter terminals TTB etc. shall not be projected outside the panel.
- Optical port and display of meter, operating control of meters shall be easily accessible for day to day operation.
- Overall design shall be esthetically very good and highly functional.
- EPC contractor shall extend fullest co-operation to purchaser for finalization of design of "projection mounting meter" during detail engineering stage.
- All ABT meters, Modems, Software's, Drivers, CMRI equipment and all related accessories shall be of the same make and model number, version etc.

5.0.0 CONSTRUCTIONAL FEATURES

5.1.0 General

5.1.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following shall be ensured:

- Personnel safety against electric shock
- Personnel safety against effects of excessive temperature
- Protection against spread of fire
- Protection against penetration of solid objects, dust and water in normal working conditions

5.1.2 All the materials and electronic power components used in the manufacture of the meters shall be of highest quality and reputed make to ensure higher reliability, longer life and sustained accuracy.

5.1.3 The meters shall be designed with application of specific integrated circuits. The electronic components shall be mounted on the printed circuit board using latest surface mount technology (SMT).

5.1.4 All insulating materials used in the construction of meters shall be non-hygroscopic, non-aging and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.

5.1.5 The meters shall have an operation indication device such as a blinking LED. The operation indicator shall be visible from the front window.

5.1.6 The front surface of meters once mounted in panel shall conform to the degree of protection IP 51 for protection against ingress of dust and moisture.

5.1.7 ABT metering panel for 132 kV system shall be of Rittal make.

5.2.0 **Sealing of the Meter**

Proper sealing arrangement shall be provided on the meter to make it tamper-proof and to avoid mishandling by un-authorized person. At least two (2) seals on the body, two (2) seals on terminal blocks and one seal each on maximum demand resetting device and communication ports shall be provided. Meter base and cover shall be tightened from rear side with at least two nos. unidirectional screws so that meter body could not be opened at site in any case and two nos. sticker seals bearing serial no., which shall not be repeated shall be provided between meter base and cover.

The meter shall be totally sealed and tamper-proof with no possibility of any adjustment at site, except for a restricted clock correction.

5.3.0 **Marking of the Meter**

The marking on every meter shall be in accordance with IS 14697 / IEC 687. The basic marking on the meter name plate shall be as follows:

i) Manufacturer's name and trade mark
ii) Type designation
iii) Number of phases and wires
iv) Serial number
v) Month & year of manufacture
vi) Reference voltage / VT ratio / frequency
vii) Rated secondary current of CT (-/1A or -/5A)
viii) Principal unit(s) of measurement
ix) Meter constant (impulse/kWh)
x) Class index of meter
xi) Text "Property of ……."
xii) P.O. No. & Date
xiii) Guarantee period

5.4.0 **Connection Diagram & Terminal Marking**

The connection diagram of the metering module shall be clearly shown in the inside portion of the terminal cover and shall be of permanent nature. The meter terminals shall also be marked and this marking shall appear in the above diagram. In case any special precautions need to be taken at the time of testing the meter the same may be indicated along with the circuit diagram.

5.5.0 **Display**

The display shall be LCD type display with back lit. Minimum height of the characters shall be 6mm.

5.6.0 **Real Time Clock**

Each of the meters shall have an independently built-in calendar and clock having an accuracy of ± 5ppm at 25 ^{0}C or better. The calendar and clocks shall be correctly set to Indian Standard

Time. The time keeping accuracy of the metering shall be maintained according to the time of load dispatch clock, synchronized with LDC.

5.7.0 **Tamper Detection Features**

There shall be an appropriate display system by which any attempt at tampering with the meter is promptly displayed with date and time tagging. The meter shall have features to detect the occurrence and restoration of, at least, the following:

a) The meter shall not get damaged or rendered non-functional even if any phase and neutral are interchanged.

b) The meter shall register energy even when the return path of the load current is not terminated back at the meter and in such a case the circuit shall be completed through the earth. In case of metallic bodies, the earth terminal shall be brought out and provided on the outside of the case.

c) The meter shall work correctly irrespective of the phase sequence of supply (only for polyphase).

d) The meter shall keep working even in the presence of any two wires i.e. even in the absence of neutral and any one phase or any two phases.

e) The registration must occur whether input phase or neutral wires are connected properly or they are interchanged at the input terminals.

f) The meter shall be factory calibrated and shall be sealed suitably before dispatch.

g) The meter shall be capable of recording occurrences of a missing potential (only for VT operated meters) and its restoration with date and time of first such occurrence and last restoration along with total number and duration of such occurrences during the above period for all phases.

h) Additional anti-tampering features including logging of tampers such as current circuit reversal, current circuit short or open and presence of abnormal magnetic field shall be provided as per the regulations.

i) Last 100 such events in total with date and time shall be stored in the meter memory on first in first out basis.

j) There shall be four separate compartments for logging of different type of tampers as follows:

- Compartment no.1: 20 events of missing potential
- Compartment no.2: 20 events of CT polarity reversal
- Compartment no.3: 40 events shall be allocated for current / voltage unbalance
- Compartment no.4: 20 events of power ON/OFF

k) The logging of various tampers in each compartment shall be as under:

Once one or more compartments have become full, the last tamper event pertaining to the same compartment will be entered and the earliest (first one) tamper event shall disappear. Thus, in this manner each succeeding tamper event will replace the earliest recorded event, compartment-wise. Events of one compartment / category shall overwrite the events of their own compartment / category only.

Tamper count shall increase as per occurrence (not restoration) of tamper events. Tamper data shall be available on meter display as:

- Date of first occurrence of tampering
- Time of first occurrence of tampering
- Time of last restoration of tampering
- Date of last restoration to normal condition
- Number of occurrence of tampering events

6.0.0 DRAWINGS, DATA AND MANUAL

6.1.0 To be submitted after award of contract:

- Technical data sheets
- Dimensional general arrangement drawing
- Scheme diagram
- Catalogues
- Quality plan
- Test certificates
- Operation and maintenance manual
- Comprehensive memory mapping and communication settings including normal and ABT parameters.

7.0.0 TESTS

7.1.0 The equipment offered shall be type tested proven type and approved by the transmission utility. Type test reports shall be furnished for approval. All routine and acceptance tests in accordance with the latest version of applicable standards shall be conducted.

7.2.0 The meter shall be duly calibrated with ESS meter of class 0.1 accuracy or better.

7.3.0 The energy meter offered shall be fully type tested for the properties / requirement, listed below at independent approved test laboratories as per relevant standards described in this specification.

7.4.0 **Following is a list of various tests that shall be conducted**

(a) Test of insulation properties:

i) Impulse voltage test
ii) AC high voltage test
iii) Insulation test

(b) Test of accuracy requirement

i) Test on limits of error
ii) Test on starting condition
iii) Test on no load condition
iv) Test of ambient temperature influence
v) Test of repeatability of error
vi) Test of influence quantities

(c) Test of electrical requirement

i) Test for power consumption
ii) Test for influence of supply voltage
iii) Test of influence short time over current
iv) Test of influence of self-heating
v) Test of influence of heating

(d) Test of electromagnetic compatibility

i) Radio interference measurement
ii) Fast transient burst test
iii) Test of immunity to electrostatic discharges
iv) Test of immunity to electromagnetic HF field

(e) Test for climatic influences

i) Dry heat test
ii) Cold test
iii) Damp heat cyclic test
iv) Test for mechanical requirements
v) Vibration test
vi) Shock test
vii) Spring -hammer test
viii) Protection against penetration of dust and water
ix) Test of resistance to heat and fire

7.5.0 **Submission of Laboratory and site testing reports.**

i) Test reports of instruments transformers, ABT meters at NABL accredited (Third Party (other than OEM) / approved laboratory and site testing reports shall be submitted to purchaser as well as to the concerned competent authority at appropriate stage.