

**OFFICE OF THE CHIEF ENGINEER / SO&C**  
**SLDC Building, 220KV Sub Station, PSEB, Ablowal,**  
**PATIALA-147001.**

**Contact No.: 0175-2365901, 2366007, 2365340 (Fax), 96461-18007 (M)**  
**Website: <http://www.psebindia.org>**

**EOI No SLDC/112/2010: Expression of Interest for supply of Static/ Electronic ABT (Availability Based Tariff) compliant Trivector Type, Four Quadrant, Bi-Directional Energy Meters of 0.2S class accuracy**

The Punjab State Electricity Board intends to approve the firms for Private Sale of Static/ Electronic ABT (Availability Based Tariff) compliant Trivector Type, Four Quadrant, Bi-Directional Energy Meters suitable for 3-phase 4-wire connections, solidly earthed system for balanced and un-balanced loads for a power factor range from zero to unity (lagging and leading) with initial and sustained accuracy of class 0.2S to consumers of PSEB. Interested parties, who are manufacturer of these types of meters, are requested to submit two sample meters without ultrasonic welding/sealing and one sample meter with ultrasonic welding/ complete sealing for each type (i.e. suitable for 1A & 5 A CT secondary rating) along with detailed literature and latest type test reports from Govt. / NABL accredited lab. Sample meters must bear serial numbers.

Price bid for the meters for private sale to consumers of PSEB along with applicable taxes/ duties/ levies/ charges etc be also submitted in a separate sealed cover along with the sample meters, which shall be opened only after the submitted meters are found to be technically suitable as per technical specification. The sample meters shall be tested in PSEB Lab in order to examine their acceptability. Further, the short listed firms may be asked to get their sample meters tested from any of the NABL accredited lab at their cost. The detailed technical specification of ABT meters (Spec No SLDC 111/ 2010) along with detailed instructions for quoting are available on PSEB website [www.psebindia.org](http://www.psebindia.org).

Interested parties may obtain further information required, if any, during office time (09.00 to 17.00 Hrs.) on working days. Offer along with sample meters & Price bid must be delivered to the address given below by 15.04.2010.

**Chief Engineer/ SO&C**  
**PSEB, Ablowal, Patiala**

## **Instructions and Terms & Conditions for interested parties**

Interested parties are advised to study & understand the technical specification of the ABT meters carefully (enclosed as Appendix-A). Applying for EOI shall be deemed to have been done after careful study and examination of the documents with full understanding of its implications, terms and conditions.

The response should be full and complete in all respects. Incomplete, partial or conditional response shall be rejected.

PSEB reserves the right to clear any doubt/ contradiction/ ambiguity/ in the stipulations of this EOI. PSEB's decision on this account will be absolute & final and binding.

The Interested parties shall bear all costs associated with the preparation of the documents and submission of the samples, including cost of presentation and verification of claims made by the applicant for the purposes of clarification, if so desired by PSEB. PSEB will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the process.

Interested parties are required to fill up the performa "Confirmation sheet for technical particulars of ABT meters" enclosed as Appendix- B & sign on the each page of the same and also give the stated certificates on letter head of the company duly signed by the authorized person of the company along with authentic document/s to prove the authority of the signatory (i.e. valid legal power of attorney in favour of signatory) must be attached)

In case the offered meters are not compatible with the existing DCD/ CMRI/ HHU already available within PSEB, then the Interested party shall also submit one suitable DCD/ CMRI/ HHU and data downloading software for BCS along with the sample and if the sample meters of the firm are approved then the firm shall give 10 No suitable DCD/ CMRI/ HHU along with the data downloading software for BCS free of cost to PSEB for meter reading purpose.

Interested parties are required to submit their price bids along with applicable taxes/ duties/ levies/ charges etc of the meters for private sale to prospective PSEB customers within Punjab in separate sealed envelopes along with their EOI.

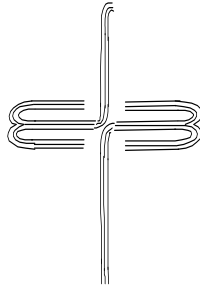
Interested parties may obtain further information required, if any, at the address given below during office time (09.00 to 17.00 Hrs.) on working days.

**Address: -**

Director/SLDC,  
SLDC Building, 220KV Sub Station,  
PSEB, Ablawal, Patiala  
Tel: 0175-2365901, 2366007  
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**Appendix-A**

**State Electricity**



## **SO & C ORGANIZATION**

Technical Specification of Availability Based  
Tariff (ABT) Type Meter  
(Accuracy Class-0.2S)

Specification No: SLDC/111/2010

**OFFICE OF CHIEF ENGINEER / SO&C,  
SLDC Building, 220KV Sub Station,  
PSEB, Ablowal, PATIALA-147001**

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## List of Abbreviations

<b>Abbreviation</b>	<b>Meaning</b>
ABT	Availability Based Tariff
AC	Alternating Current
AMR	Automated Meter Reading
API	Application Programming Interface
BIS	Bureau of Indian Standards
BCS	Base Computer System
CBIP	Central Board of Irrigation & Power
CD	Compact Disc
CEA	Central Electricity Authority
CMRI	Common Meter Reading Instrument
COM	Component Object Model (Software Components Terms)
CRCA	Cold Rolled Close Annealed
CVT	Capacitive Voltage Transformer
CT	Current Transformer
DC	Direct Current
DCD	Data Collection Device
DCOM	Distributed COM (Software Components Terms)
DLMS/COSEM	Device Language Message Specification/ COmpanion Specification for Energy Metering
EHV	Extra High Voltage
ESD	Electrostatic Discharge
GPS	Global Positioning System
GSM/GPRS	Global System for Mobile Communication/ General Packet Radio Service
HV	High Voltage
$I_b$	Basic Current
IEC	International Electro technical Commission
IP	International Protection Rating/ Ingress Protection Rating
$I_{r-Ph}, I_{v-Ph}, I_{b-Ph}$	Respective Phase Current
IS	Indian Standard
ISI	Indian Standard Institute
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MD	Maximum Demand
MIOS	Meter Inter Operable Solutions
NABL	National Accreditation Board for Testing and Calibration Laboratories
NVM	Non Volatile Memory
PC	Personal Computer
PCB	Printed Circuit Board
PF	Power Factor
PSEB	Punjab State Electricity Board
PSGC	Punjab State Grid Code
PT	Potential Transformer
QA	Quality Assurance
RTC	Real Time Clock
TTB	Test Terminal Block
UPF	Unit Power Factor
VB	Visual Basic
VBA	Visual Basic for Applications
Vref.	Reference Voltage
$V_m, V_{vn}, V_{bn}$	Respective Phase Voltage
VSAT	Very Small Aperture Terminal
VT	Voltage Transformer

## Technical Specifications of Availability Based Tariff Type Meter

### 1.0 Scope:

The specification covers the design, engineering, manufacture, assembly, and testing of Static/ Electronic ABT (Availability Based Tariff) compliant Trivector Type, Four Quadrant, Bi-Directional Energy Meter, suitable for 3- phase 4-wire connections, solidly earthed system with balanced and un-balanced loads for a power factor range from zero to unity (lagging and leading), with initial and sustained accuracy of class 0.2S. The meter shall be installed for EHV/ HV circuit, as a self-contained device for measurement of active energy transmittals in each successive 15-minutes block etc. meeting the ABT requirements and certain other functions, as described in the following paragraphs/ sections of this document. The meter shall be suitable for being connected to voltage transformers (VTs) having a rated secondary line-to-line voltage of 110 V, and to current transformers (CTs) having a rated secondary current of 1A/5A. Any further transformers/ transducers required for their functioning shall be inbuilt in the meter. Necessary isolation and/ or suppression shall also be built-in for protecting the meter from surges, voltage spikes, fault-currents, EMI etc. that occur in the VT and CT circuits of extra high voltage switchyards. The reference frequency shall be 50 Hz. The energy meter shall be rack/ panel/ metal box mounted with individual/ common/ both types of displays.

### 2.0 Standards:

While drafting this specification, reference has been made to Punjab State Grid Code, National and International standard specifications with latest amendments. In case, if certain details are not covered in this specification, the relevant State Grid Code/ Indian/ International standard shall be applicable:

IS-14697: AC static Watt Hour Meter for Active energy (Class-0.2S) with latest amendments

IEC-60687: Static Watt hour meter for class 0.2s with the latest amendments

CBIP Tech. Report No.88 (Revised with Latest amendment), with latest amendments

CBIP Tech. Report 111 for common Meter Recording instrument and optical Ports  
in use, with latest amendments

IS-9000 Basic Environmental Testing Procedures for Electronic and Electrical Items.

PSGC (Punjab State Grid Code)

The meter shall be ISI marked and shall fully comply with all stipulations in applicable standards with latest amendments/ the relevant provisions of Punjab State Grid Code, except those specifically modified by this specification.

### 3.0 ABT Specific Requirements:

- a) **Net Active Energy:** The Active Energy (Wh) measurement shall be carried out on 3-phase 4-wire principle with accuracy as per Class 0.2s. The energy shall be computed directly in CT and VT secondary quantities. The meter shall compute the **Net Active Energy** (Wh) sent out from the substation bus-bars during each successive 15-minutes block, and store it in its memory along with plus/ minus sign i.e. the positive sign if there is a net energy export, and a minus sign if there is a net energy import. Net Active Energy sent out up till that moment in the current block as well as net active energy sent out for the immediate previous block shall be displayed while scrolling.
- b) **Reactive Energy:** The meter shall also compute the **Reactive Power** (Var) on 3-phase 4-wire principle, with an accuracy as specified and integrate the **Reactive Energy** (Varh) algebraically into two separate registers, one for the period for which the average of RMS voltages of all 3-Phases is 103.0% or higher, and the



1	Current – I <sub>r</sub> , I <sub>y</sub> , I <sub>b</sub>	Y	N	Y	N	N
2	Voltage- V <sub>m</sub> , V <sub>yn</sub> , V <sub>bn</sub>	Y	N	Y	N	N
3	Average of RMS Voltage as Percentage of 63.51 V	Y	N	Y	N	N
4	Power Factor	Y	N	Y	N	N
5	Frequency – (Hz)	Y	N	Y	N	N
6	Apparent Power	Y	N	Y	N	N
7	Active Power	Y	N	Y	N	N
8	Reactive Power	Y	N	Y	N	N
9	Real-Time Clock (Date & Time)	Y	N	Y	N	N

**15-Minute Block Level Power Quantities (For 45-days):**

Sr.	Parameter	Scrolling/ Cyclic Display		Remote Reading (Current Block Instantaneous as well as Immediate Previous Block)	Storage at the end of the block	ABT Billing Related
		Current Block	Immediate Previous Block			
1	Active Energy Import	Y	Y	Y	Y	N
2	Active Energy Export	Y	Y	Y	Y	N
3	Frequency (Hz) – Average	Y	Y	Y	Y	Y
4	Reactive Energy Lag Import	Y	Y	Y	Y	N
5	Reactive Energy Lead Import	Y	Y	Y	Y	N
6	Reactive Energy Lag Export	Y	Y	Y	Y	N
7	Reactive Energy Lead Export	Y	Y	Y	Y	N
8	Net Active Energy	Y	Y	Y	Y	Y
9	Frequency (Coded 00-99)	Y	Y	Y	Y*	Y



	for 49.00-51.00 Hz)					
10	Apparent Energy Import	Y	Y	Y	Y*	N
11	Apparent Energy Export	Y	Y	Y	Y*	N
12	Total Energy (Fundamental + Harmonics)	Y	Y	Y	Y*	N

\*(Optional depending upon availability of Storage)

**Day Level Power Quantities (For 45 days):**

Sr.	Parameter	Scrolling/ Cyclic Display		Remote Reading (Current Day Instantaneous as well as Immediate Previous Day))	Storage at the end of the day	ABT Billing Related
		Current Day	Previous Day			
1	Day's Active Energy Import	Y	Y	Y	Y	N
2	Day's Active Energy Export	Y	Y	Y	Y	N
3	Net Cumulative Active Energy	Y	Y	Y	Y	N
4	Day's Reactive Energy High (V>=103%)	Y	N	Y	Y	Y
5	Day's Reactive Energy Low (V<=97%)	Y	N	Y	Y	Y
6	Count and Max/Min Duration of power off of feeder.	Y	N	Y	Y	N
7	Duration of Power off hours of the feeder.	Y	N	Y	Y	N
8	Apparent Energy Import	Y	Y	Y	Y	N
9	Apparent Energy Export	Y	Y	Y	Y	N

**Perpetual Type Power Quantities:**

Sr.	Parameter	Scrolling/ Cyclic Display		Remote Reading (Instantaneous)	Storage	ABT Billing Related
		Current Block	Previous Block			
1	Cumulative Active Energy perpetual counter in Wh(Separate for import & export as in conventional bidirectional energy meter)	Y	Y	Y	Y	N

**Note:** Signs may be used to represent Export/ Import/ Lag/ Lead in concurrence with the general scheme as specified in “ABT Specific Requirements” section.

## **5.0 Meter Display:**

Each of the rack/panel/metal-box shall have alphanumeric common/ individual/ both type of legible/ easily readable and visible (even during the night) display for indication of the meter parameters one by one of all the Instantaneous Parameters, the current as well as immediate previous 15 minutes block, Day Level parameters & Perpetual type parameters as specified . These parameters shall be auto-displayed through scrolling/ cyclic display etc. with scroll lock facility. Auto scrolling/ cyclic display etc. shall be visible when any one of the specified power supplies is available.

Besides the quantities specified in the section “Other Power Quantity Measurements Requirements”, the following measured/ calculated values/ quantities shall also scroll/ cycle continuously:

- i) Meter's identification code and model as specified as well as unique meter serial number.
- ii) Date (DD/MM/YYYY), Time (HH24:MM) & Current Block No
- iii) Last recorded anomaly/ fraud/ incident log etc. as specified in this specification.

The display shall automatically come back to scrolling mode if push button is not pressed for say 3 minutes. The display shall meet with the condition of minimum roll over period stipulated in clause 6.10 of IS: 14697:1999. The display shall have a good readability & visibility, with back lighting if required.

The size of Displayed digits shall be minimum 10mm height. Display size should be such, so as to display complete/ multiple values as per the type of the contents. While displaying the values, the identification of each value shall be possible preferably through full quantity name or through easily understandable mnemonics/ abbreviations etc. Display must be electronic. LCD/ LED display must have a life at least equal to the life of the meter. The minimum guaranteed life in years of LCD/ LED should be clearly brought out by the manufacturer.

## **6.0 Data Storage Requirements/ Meter Storage Capacity:**

Each meter shall have a Non-Volatile Memory (NVM) in which various parameters as specified shall be stored. Meter shall have storage capacity (Non-volatile) for the specified meter data in its memory for at least a period of 45 days. All the data shall be stored in the form of arrays. The older data shall not get erased unless replaced by fresh data. NVM, which does not require any battery backup shall have minimum retention period of 10 years. Battery backed up memory will not be considered Non-Volatile.

## **7.0 Monitoring of Voltages:**

The three line-to-neutral voltages shall be continuously monitored and in case any or all of these falls below about 70% the condition shall be suitably indicated and recorded in the logs. The indication details shall be given on the front of the meter. The time blocks in which such a voltage failure occurs/ persists shall also be marked, for example with star (\*), while storing in the meter's memory. The indication shall automatically become normal when VT secondary voltages are healthy again. The two specified Varh registers shall remain stay-put while VT supply is unhealthy.

## **8.0 Special Power Quantity Measurement/ Display/ Storage/ Protection requirements:**

- a) The meter will do calculations, display & store the various values in CT/ PT secondary power quantities.
- b) Meter data in secondary quantities for display and storage shall have minimum 8 digits including one decimal digit for cumulative values and 2 decimal digits for other power quantities.
- c) No rounding off to the next higher last decimal shall be done for voltage and frequency. All 15-minutes Wh figures shall however be rounded off to the nearest last decimal.
- d) The meter shall safely withstand the usual fluctuations arising during faults etc. The various limits shall be as per the relevant standards with latest amendments. These fluctuations shall not cause any damage to or mal-operation of the meter and shall retain the data under any adverse system conditions.  
The meter should start registering energy at 0.1% of basic current ( $I_b$ ) at UPF or lower. Rated maximum current shall be 1.2 times of  $I_b$
- e) The meter shall continue to function for the remaining healthy phase(s), in case one or two phases of VT supply fails. In case of a complete VT supply failure, the computation of average frequency shall be done only for the period during which the VT supply was available in the 15-minutes block.
- f) Any time block contraction or elongation for clock correction shall also be duly accounted for and logged.
- g) Errors in the energy measurement for all power factor angles from  $0^\circ$  to  $360^\circ$  shall be as per the standards specified in this specification.
- h) The harmonics shall be filtered out while measuring Wh, Var and Varh and only fundamental frequency quantities shall be measured, computed, displayed & stored. Meter shall also measure, compute & display the Total Energy in Wh consisting of fundamental & harmonic energy for each 15-minute block separately.
- i) The Electrical Requirements (Power Consumption, Influence of Supply Voltage, Influence of Self Heating, Influence of Heating, Insulation, Immunity to Earth/ Phase faults etc.), Electromagnetic Compatibility, Accuracy Requirements, Meter Constructional Requirements, Marking of Meter, Test & Test Conditions etc. shall be as per the relevant standards unless specifically modified in these specifications.
- j) The meter shall have the provision of recording/display Maximum Demand, MD resetting and MD Count also.

**9.0 Climatic Conditions:** The meter shall be suitable to work satisfactorily under the climatic conditions of temperature & humidity as defined in the relevant standards. Further climate conditions of Punjab should also be kept in view (listed as per Annexure-I)

**10.0 A.C. Supply System:**

The supply shall be through CT & PT connection of the respective EHV/ HV feeder as follows.

- a). Rated secondary voltage  $V_{ref}$  : 110V Phase to Phase ( $110/\sqrt{3}$ V P.N.)
- b). Rated secondary current of CTs  $I_b$ : 1Amp/ 5 Amp
- c). Voltage variation : V reference + 20% to -30%
- d). Frequency : 50HZ +/- 5%
- e). Power Factor : Zero to unity (lagging or leading)  
in all the four quadrants
- f). System : 3-phase 4-wire

**11.0 Test Output:**

Each meter shall have a test output device (visual) for checking the accuracy of active energy (Wh) measurement as per the relevant standards. Test output device may be in the form of a pulse indicator accessible from the front and capable of being monitored by suitable testing equipment as per the relevant standards.

## **12.0 Self Diagnostic Feature:**

The meter shall be capable of performing complete self diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location all the time. The meter shall have indications for unsatisfactory, nonfunctioning & malfunctioning of the following at least:

- a) Internal Clock/ Date and Time with respect to the DCD/ CMRI/ GPS etc.
- b) All display segments as per the requirement under G 19 of IS 14697.

The details of any type of malfunctioning should be logged with time and date in the meter. The details of self-diagnostic capability feature should be furnished by the meter manufacturer.

## **13.0 Meter Power Supply Arrangement:**

The meter must be capable to operate with the power drawn from the PT/CVT secondary circuits. The total burden imposed on CTs & PTs by the meter for measurement and operation shall be as per the relevant standards. While operating with supply from PT/CVT, the meter shall not require any separate auxiliary supply for their normal operation.

Further, the meter shall be capable to display & data downloading of the stored quantities through either an internal in-built or external power pack battery. The batteries provided for Display/ Optical Port downloading etc shall have life of not less than 10 years. The batteries shall not get damaged or damage the meter even during idle storage of the meter for two years. Adequate protection must be in built to safeguard against damage to meter on account of application of high or wrong type of voltage at external battery terminals etc.

## **14.0 Clock Battery:**

The clock operation in the meter shall not be disturbed in any event. In case of failure of power supply, the meter shall be capable of continued operation of the meter's calendar-clock with the help of internal clock battery. The batteries provided for RTC shall have life of not less than 10 years. The battery shall not get damaged or damage the meter even during idle storage of the meter for two years.

## **15.0 Real Time Clock**

Each meter shall have a built-in calendar and clock, having an accuracy of  $\pm 2$  minutes per year or better. The calendar and clock shall be correctly set at the manufacturer's works to the Indian standard time. The date (dd/mm/yyyy) and time (HH24: MM) shall be displayed on the meter front while data scrolling. Feature for keeping the time of clocks synchronized with GPS device time should be available via communication port. Meter Software shall have provision for recording reading on 29th Feb. of leap year without manually intervention/ setting etc.

Limited clock adjustment shall also be possible at site, in case of GPS device/ system is not provided, by using the DCD/ CMRI. When an advance or retard command is given through DCD/ CMRI, 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 corrections shall be logged in the meter's memory and suitably shown on print out of collected data.

Further if the meter clock has drifted so much that it is not possible to correct the meter clock as specified in this specification then it must also be indicated/ logged in the log files. All attempts to synchronize/ actual synchronizing of the meter clock through DCD/ CMRI may also be indicated/ logged in the log files.

## 16.0 Programmable Parameters:

The meter may have following Programmable (P)/ Non Programmable (NP) parameters:

Sr.	Information	Type	Pass word	From		
				Meter	DCD/ CMRI	Remote/ BCS/ Master
1	Real Time Clock	P	Y	N	Y (Limited as specified)	Y
2	Demand Integration Period	P	Y	N	Y	Y
3	Meter ID/ Identification	P	Y	N	Y	Y
4	Relevant settings in respect of ports for communication	P	Y	N	Y	Y

The change in programmable parameters must be logged. The supplier shall furnish details of all the programmable parameters/ facilities under following categories (i) Factory Programmable (ii) User Programmable.

## 17.0 Communication Capabilities:

Each of the meter/ meter rack shall be provided with an accessible & sealable galvanically isolated Optical port (i.e. IEC 1107 etc.) & a communication port (i.e. RS-485 port etc.) with open standard protocols. Both the ports shall be of universal type conforming to relevant standard so that these can be easily connected to a DCD/ CMRI/ MODEM (e.g. GSM/ GPRS/ CDMA/ PLCC/ Microwave/ Radio/ VSAT/ Leased Line/ PSTN/ VPN/ Ethernet etc.)/ Laptop/ PC/ GPS Time device for data communication/ time synchronization etc. The ports shall be integral part of body and sealable. There shall be provision of passwords for online/ offline data retrieval/ changing the configuration. Collected data in meter shall not be reprogrammable/ modifiable through any of the externally provided or internally provided (if any) ports for maintaining data integrity.

**Optical Port:** The overall **intention of the optical port** for each meter (or a common optical port for a meter rack) on its front is to tap the data stored in the non-volatile memory/ time correction/ limited configuration changes thorough Portable or hand held data collection device (DCD/ CMRI). The DCD/ CMRI shall serve as the interface between the meter specified above and the personal computer (PC). It shall also be possible to obtain a print out (hard copy) of all data collected from the meter, using the local PC. Time required for downloading the complete stored data/ logs etc must be reasonable & practicable and mentioned by the manufacturer.

**Communication port:** The overall **intention of communication port** is for **online data communication** of all the instantaneous/ current averages/ cumulative values and **offline data retrieval/** tapping of stored values through open standard protocols through suitable communication device/ media from personal computer/ data collection center/ Base Computer systems/ AMR systems etc. The Host/ Base station & the meter shall follow Master-Slave relationship with meter as slave.

For the purpose of **Online data communication**, Instantaneous/ present averages/ cumulative values means the actual values at the latest instance of time. These values will be continuously updated by the meter hardware as per internal sampling and computation time. The value read is always the last updated and shall be date and time stamped. The measurement and computation of each of these parameters shall be based on accepted methods. At any instant a snap shot of all/ any selected out of the instantaneous/ current averages/ cumulative values shall be readable by the host. Further during online response, the meter may indicate to the master about its emergent status (such as log overflow, storage capacity overflow etc, anomaly, attempted fraud etc, if any) so that master may take appropriate action in advance.

The purpose of **Offline data communication** is to get stored values/ logs/ Name plate details/ current configuration details etc as well as remote programming of defined programmable parameters/ time synchronization commands etc from master to the meter. Offline data will normally be downloaded once a day (after midnight) but it must be possible to download it any time for any period (out of available data in meter storage) as the master/ host system may desire.

Offline data be downloadable in suitable chunks so that Host/ master may prioritize online & offline communication simultaneously, and also that offline data communication once started may not hang/ clog data communication path keeping in view its bulk.

Online/ Offline Data communication operation shall not erase the data from the meter's memory, or effect the meter operation in any way. No hardware and software changes except configuration changes may be required for online/ offline communication through comm. port when ever the port may be used with suitable communication as and when desired or decided.

Further the meter manufacturer must supply the details, settings & requirements of the open protocol which will be necessary for interfacing the meter with the personal computer/ data collection center/ Base Computer systems/ AMR systems etc for online and offline data communications

Note: CEA on the initiative of MOP has recommended DLMS/ COSEM (IEC62056) as an open standard protocol for energy meter in India. Till companion standards for this protocol are published by BIS, Meter Manufacturers may supply meter with MIOS based protocol with complete details/ APIs so that latter on when companion standards are available both type of meter be able to be interfaced with single base computer station/ master control center.

#### **18.0 DCD/ CMRI & PC Software (Basic Utilities):**

The meter supplier/ manufacturer shall provide the necessary licensed software which would enable an IBM-Compatible PC to:

- a) Accept the data from the DCD/ CMRI (especially from DCD/ CMRI already available within PSEB procured from M/s Signals & Systems (India) Pvt. Ltd., Chennai bearing model No. CMRI – 1010) and/ or from an interface device connected to the Optical Port and store it in a tamper proof file in binary/ encrypted/ password protected etc read only format for tapping all data stored in a meter's memory and faithfully transferring it to the IBM Compatible PC. The intention is to ensure absolutely no tampering (except total erasure) of the collected data file while handling that file with PC.
- b) For reading that binary/ encrypted/ password protected etc. read-only data file, the meter supplier must give a utility program/ software to convert that data to MS Excel format/ text file etc. Also there should be utility to verify the converted file against original tamper proof file as and when desired. Use of both the utilities must be user friendly/ understandable by a computer savvy person/ easy to use with requisite help/ documentation. The above two utilities must also be available free of cost as an ActiveX/ COM/ DCOM etc component (with complete documentation with examples source code snippets in VBA/ VB/ C etc) so as to be useable as an embedded software component with third party Billing/ Base station software.
- c) Name of the data file should be such that meter should be identifiable preferably data period shall also be identifiable. For example the Name of the data file for Meter with Sr No xxxxxxxx and with data for the period 01/02/2009 to 28/02/2009 could be xxxxxxxx\_20090201\_20090228.dat etc.

- d) Data collected above through DCD/ CMRI must show all the values of stored quantities as specified as well as the set values of all the programmable parameters, Meter Name Plate Details as well as logs of Parameter Changes/ Clock Correction/ Abnormal Conditions / Tamper/ Fraud Conditions etc.
- e) The software for PCs & DCD/ CMRIs shall be supplied in suitable and compatible form/ media to enable its easy loading into the IBM-Compatible as well as existing DCD/ CMRIs in PSEB along with backup copies on CD.
- f) Data tapping operation shall not erase the data from the meter's memory, or effect the meter operation in any way.
- g) The software in DCD/ CMRI shall be simple to operate & foolproof. For example the data tapping from the coupled meter's memory shall start on pressing of a key, another key to start data transfer to the PC, and an indication, which would indicate completion of data collection, keep indicating while the data is held in the device and would stop indicating when all data has been transferred to the PC etc.
- h) DCD/ CMRI software shall also have the necessary feature for time synchronization/ setting of the real time clock of the SEMs while downloading of the data as specified. The DCD/ CMRI software should have features to manually set/ auto synchronize with BCS, the time in itself before hand. Further if the meter clock has drifted so much that it is not possible to correct the meter clock as specified then it must also be indicated in the log file being transferred to the DCD/ CMRI from the meter. Also attempts to synchronize/ actual synchronizing of the meter clock through DCD/ CMRI be also indicated in the log files.
- i) In case of any discrepancy in tapping of meter data by DCD/ CMRI (i.e. DCD/ CMRI already available within PSEB procured from M/s Signals & Systems (India) Pvt. Ltd., Chennai bearing model No. CMRI – 1010), ABT meter supplier shall install the required software in DCD/CMRI for making it compatible with the ABT meter software. However, if due to some reasons the existing DCD/ CMRI are not suitable, then the meter manufacturer must also supply the DCD/ CMRI.
- j) Collected data shall be stored on the base computer in original tamper proof binary/ encrypted format file as well as MS Excel/ Text file.
- k) It should be possible to display & print the collected data on PC's screen in MS-Excel / Text format.
- l) It should be possible to store the original collected data in binary format, on a floppy disc/ CD/ DVD/ Pen drive.
- m) The DCD/ CMRI software should be suitable for reading, down loading of multiple meter data, Time Setting in DCD/ CMRI, Time correction for Meter as specified, and other relevant configurations/programmable parameters in the meter. All such changes/ configurations should be password protected and logged in the meter with date & time.
- n) The necessary training if required as well as detailed & easily understandable manuals/ documentation for this purpose shall also be provided.

### **19.0 Sealing of Meter:**

Proper sealing arrangements shall be provided on the meter to make it tamper-proof. Provision of at least two seals on the meter body, one seal on the terminals block and one separate seal on optical port should be available. Sealing arrangement of communication port must also be provided.

### **20.0 Meter Construction:**

The meter shall be made of high quality materials/ components to ensure high reliability and long life. The meter shall be supplied housed in compact and sturdy, metallic or moulded cases of non-rusting construction and finish. The cases shall be designed for

mounting on a plane, vertical surface such as a control & relay panel front/ inside a metal box etc. All terminals for CT and PT connections shall be arranged in a row and shall have easy accessibility when terminal cover is open and no accessibility when terminal cover is closed. Terminals shall have a suitable construction with barriers and cover, to provide a secure and safe connection of CT and PT leads through stranded copper conductors of 4 sq mm sizes. Minimum Clearance & Creepage Distance shall be as per the relevant standards.

The meter shall also withstand without any damage or mal-operation reasonable mechanical shocks, earthquake forces, ambient temperature variations, relative humidity etc as per relevant standards. They shall have an IP-51 of ISI2063 category dust tight construction, and shall be capable of satisfactory operation in an indoor, non-air conditioned installation. It shall be immune to vibration and shocks during transportation and handling. It should also be immune to external magnetic & electric fields as per CBIP-88-June 2000 edition.

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

The meter shall be designed with application of specific integrated circuits. The electronic components shall be mounted on the printed circuit board. All insulating materials used in the construction of meter 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. Any protective coating shall not be liable to damage by ordinary handling nor damage due to exposure to air under normal working conditions

The meter shall have operation indication device such as a blinking LEDs and/ or LCD indications, alphanumeric display, sealing arrangements, mounting arrangements etc as specified in this specifications. The terminal cover design shall be pilfer proof.

Meter shall be designed and constructed in such a way so as to avoid causing any danger during normal use. However the following should be ensured:

- (i) Personnel safety against electric shock
- (ii) Personnel safety against effects of excessive temperature
- (iii) Protection against spread of fire
- (iv) Protection against penetration of solid objects, dust and water in normal working condition.
- (v) Protection against fraud/ prevention against pilferage.

The meter construction should conform to CBIP reports with latest amendments.

## **21.0 Metering Cubicle:**

In case of rack type meter, a MS metering cubicle shall also be provided to mount the meter and associated TTBs. Metering cubicle (i.e. Rack/Panel/Metal Box) shall be designed to accommodate one/two racks/ rows each with 2/3/4 meter. Metering cubicle shall be pre-wired and shall have door switch and space heater controlled by thermostat and switch. The cubicle shall be made of 2 mm CRCA for load bearing members and 1.6 mm CRCA for doors and covers. The cubicle shall be conforming to IP-54 of ISI2063and



properly treated and painted with light grey shade no 631 as per IS5. Optionally in case of Metering Cubical a common Display, common Optical Port & common communication port may be provided.

## **22.0 Connection Diagram & Terminal Marking:**

The general scheme of Connection Diagram & Terminal Marking shall be as per the relevant standards. The connection diagram of the metering module shall be clearly shown appropriately on the meter. The meter terminals shall also be marked and this marking should appear in the above diagram. In case any special precautions need to be taken at the time of testing/ installation of the meter the same may be indicated along with the circuit diagram. Phase sequence shall be marked on the diagram of connections.

## **23.0 Quality Assurance:**

The meter manufacturer must have a quality control/ assurance (QA) procedure/ plan for manufacturing of the specified equipment generally based on the established and proven practices of the manufacturer.

## **24.0 Type/ Routine Tests**

Meter must be Type tested and Type test certificates issued by any national laboratory accredited from NABL for the offered model shall be made available. The Type tests as well as Routine tests shall be carried out strictly as described in the relevant sections of IS 14697/ CBIP technical report -88 publications and with latest amendments thereafter.

## **25.0 Acceptance Testing**

### **A) Meter:**

Meter shall be duly tested & certified that it is suitable for the purpose as per the relevant standards & CBIP-88 report (Latest Amendments). In addition, each and every meter shall be subjected to the following acceptance tests:

- a) Functional checks for display and memory.
- b) Accuracy of the calendar and clock. (Method should be given by the manufacturer)
- c) Accuracy of Wh, Varh, voltage, frequency measurement etc. shall be checked at the steps of 0.5 Hz over the full frequency range.
- d) Testing of internal/ external power pack battery arrangement as well as meter Burden/ Wattage
- e) Testing for all tampers, frauds and anomaly may be carried out for compliance as specified.
- f) Working, suitability, functions etc of Optical Port as well as communication port as specified.

### **B) Acceptance Testing of DCD/ CMRI software and PC software:**

DCD/ CMRIs software and PC software (utilities) supplied by the meter supplier must be installable on the specified DCD/ CMRIs & PCs to verify that they are suitable/ user friendly for the specified purpose. Both software after installation as specified shall be subjected to the following acceptance test:

- a) Method of installation on DCD/ CMRI as specified
- b) Functional checks as specified
- c) Downloading Meter Data from the Meter through optical port
- d) Downloading data/ file to PC as specified
- e) Tamper proof nature of the data/ file downloaded to the PC.
- f) Conversion of the data file to MS Excel/ Txt format as specified and verification of such converted files against original data files from meter.
- g) Functioning of auto time synchronization/ setting of the real time clock of the meter while downloading of the data or otherwise as specified.

- h) The DCD/ CMRI software should have features to set/ synchronize the time in itself before hand.
- i) Proper functioning of advance and retard time commands.
- j) Per meter downloading time verification
- k) Capacity of DCD/ CMRI software for data storage

**26.0 Manuals:**

The meter must have detailed user friendly manual having operational details, configuration change procedures and maintenance procedures of meter/ DCD/ CMRI software/ PC software and also shall provide the Memory mapping detail of the Meter for online & offline monitoring. A user-friendly manual covering remedial measures to be taken by the users in day to day operation of Meter/ DCD/ CMRI is required to be provided by the manufacturer.

**27.0 Warranty**

The meter should carry a warranty for a period of 5 years. The meter shall be warranted for a period of 5 years from the date of receipt of supply. If any equipment/ meter/ software fail during this period, the firm shall carry out free replacement within 30 days of notification.

**28.0 Packing:**

The meter shall be properly packed in suitable packing to avoid damage or disturbance during transit or handling, to ensure their safe arrival at destination and long-term storage. Each meter may be suitably packed in the first instance to prevent ingress of moisture and dust and placed in a cushioned carton of a suitable material to prevent damage due to shakes in transit. The lid of the carton may be suitable sealed. A suitable number of sealed cartons may be packed in a case of adequate strength with extra cushioning, if considered necessary. The cases may be than properly sealed against accidental opening in transit. The packing cases may be marked to indicate the fragile nature of the contents.

**29.0 Tamper, Fraud, Anomaly Detection/ Logging of Incidents:**

The meter shall have the following special features to prevent/ detect common ways of tamper and fraud and record/ log the same with date & time of occurrence, duration, count etc. However detection mechanism should ignore momentary/ transient occurrences of these, which are below appropriate thresholds and specify the same clearly in the meter manual/ literature.

- a) **Phase sequence Reversal:** The meter shall keep working accurately irrespective of the phase sequence of supply.
- b) **Missing Potential:** The meter shall record/ log occurrence of missing of one/ two potential as per the relevant standards.
- c) Meter shall work accurately during the tamper conditions of neutral disturbance i.e. when DC voltage/ High Frequency is fed to neutral.
- d) The meter should be provided with magnetic shielding so that any external magnetic field (AC/DC Electro magnetic or Standalone Magnet) as per the value specified in CBIP reports no. 88 with latest amendments) should not affect the proper functioning of the meter.
- e) Accuracy of the meter should not be affected with the application of the abnormal radiations/ voltages/ frequencies generating devices any where on the phase/ neutral circuits etc. The accuracy of the meter should be checked before, & after these applications, and the accuracy of the meter during tamper shall be as per latest CBIP reports
- f) Meter shall record the energy accurately under the effect of radiation emitted by mobile phone or such other devices. The test shall be carried out by bringing a mobile phone in the close proximity of the meter for 10 minutes when there is an incoming call and shall be checked under the following conditions:
  - i) 10%  $I_b$  at UPF

- ii) 50%  $I_b$  at UPF
  - iii) 100%  $I_b$  at UPF
  - iv) 120%  $I_b$  at UPF
- g) The offered meter shall also be capable to withstand and shall not get damaged if phase to phase voltage is applied between phase and neutral.
  - h) The meter should register energy correctly even when the load is not terminated back to the meter and instead the current is drawn through a local earth.
  - i) Tamper information and readings/ stored data should not be modifiable through CMRI or P.C. / Ports.
  - j) In case more than one tampers exist simultaneously/ then meter shall record all the tampers with date and time of occurrence/ duration.
  - k) Power Supply failure: The meter shall log the cases of failure of Self Power i.e. PT/CVT and its restoration with date and time.
  - l) Tampering data/ events should be recorded/ logged with date and time, firstly as per the recommendations of CBIP-88 Report (Latest Amendments), secondly as per the Relevant Standards or lastly as specified in the Specification in the relevant sections, in that order. And if not covered/ specified in any of the above then the recording should be to log the first occurrence and of last restoration along with total number and total duration of all such occurrences during the above period. It shall also record instantaneous data (for each phase) i.e. voltage, current, P.F. etc. Tampers shall be recorded if it persists for 1 minute continuously and once a tamper is detected by crossing the 1 minute threshold, any momentary normalizations/ restoration for less than 5 minutes thereafter be taken as single continuous temper. However if some tamper is repeatedly/ excessively occurring for duration even less than 1-minute threshold, it shall also be logged.
  - m) The meter shall have an appropriate display system by which any attempt of tampering the meter is promptly displayed with date and time tagging.
  - n) In case of any anomaly/ fraud/ tamper/ battery failure (preferably in advance)/ clock failure/ configuration change etc the meter should have a provision for alarm/ indication. However details of that particular exception should be stored & available through display. Latest one exception (with date/ time) should also scroll in the display along with the instantaneous values as specified. At least 350 Nos. tampering/ exception events (count, occurrence, restoration and duration) shall be logged with date and time.
  - o) Other possible tampers/ anomalies which can be detected/ logged be brought out by the vendor.

### 30.0 Meter Identification/ Name Plate Details/ Marking of Meter:

Each Meter shall bear the information as per the relevant standards. Each meter shall have a unique serial number given by manufacturer, which shall be marked permanently on its front, as well as in its memory. Besides unique meter serial number the meter shall have the provision for programming Meter ID/ Identification code/ string (at least 20 Characters) through DCD/ CMRI, Other markings on the meter shall be as per the relevant standards.

Further, Name Plate details as given below should also be available to be downloadable with DCD/ CMRI operation as well as through remote via comm. port.

#### Name Plate Details:

Sr.	Information
1	Meter Serial Number
2	Meter Constant (impulse/Wh)
3	Accuracy

4	Make
5	Model/ Designation of Type
6	Month/ Year of Manufacture
7	Configuration/ Settings
8	Firmware version
9	Rated secondary current of CT (1A or 5 A).
10	Reference Voltage, Frequency
11	Principal unit(s) of measurement
12	Warranty/ Guarantee Period etc

**31.0 Disclosure requirements:**

Besides as stated in the relevant sections of the Specification, the meter manufacturer must also give the principle of operation of the meter, outlining the method and stages of computation of various parameters starting from input voltage and current signals including the sampling rate if applicable should be furnished by the supplier. The manufacturer should indicate the method adopted to transform the voltage and current to the desired low values with explanation on devices used such as CT, PT or Potential divider as to how they can be considered superior in maintaining ratio and phase angle for variation of influence quantities and during its service period. Details of memory used in the meter should be furnished by the manufacturer. This is in confirmation with the CBIP-88 reports

**CLIMATIC CONDITIONS**

<b>Sr. No.</b>	<b>Particulars</b>	<b>Conditions</b>
1	Maximum temperature of air in shade	50°C
2	Minimum temperature of air in shade .	(-) 5°C
3	Maximum temperature of air in contact with metallic portion in sun	60 °C
4	Maximum daily average ambient temperature.	40°C
5	Maximum yearly average ambient temp.	35°C
6	Maximum relative humidity.	95%
7	Average number of thunder- storm days per annum.	60
8	Average number of dust storm days per annum.	40
9	Average number of days of fog per annum.	70
10	Average number of hailstorm days per annum.	5
11	Average number of rainy days per annum.	60
12	Average annual rain fall	More than 76cms
13	Number of months during which tropical monsoon conditions prevail.	3
14	Maximum wind pressure.	150kg/sq.M
15	Altitude above M.S.L.	Not exceeding 1000 mtrs
16	Sites are susceptible to earthquakes. The earthquake forces for which equipment to be designed : a) Horizontal direction b)Vertical direction	0.3g 0.15g
17	Atmospheric pollution.	Heavy

## Confirmation Sheet For Technical Particulars Of ABT Meters

(For private sale to consumers of PSEB)

Specification No. SLDC 111 / 2010

**ABT Meters must conform to minimum parameters specified in various clauses of the Specification No SLDC 111/ 2010**

S.N.	Description	Details/ Deviation/ Additional Features/ Remarks		
<b>A</b>	<b>Basic Particulars</b>			
1.	Manufacturer's Name & Country			
2.	Meter Make/ Model			
3.	Type			
4.	Class of Accuracy			
5.	Basic Current			
6.	Max. Continuous Current (A).			
7.	Standard reference voltage (V).			
8.	Standard reference frequency (HZ).			
9.	Power loss in each current circuit at basic current.			
10.	Power loss in each voltage circuit at reference voltage and frequency.			
11.	VA Burden on CT/PT Circuit			
12.	Whether meter carries ISI mark.			
13.	a) Over load capacity b) Voltages & frequency range over which the meter functions satisfactory			
14.	Details of Rating a) Voltage b) Current			
15.	Expected Life of the meter			
16.	Dimensions			
17.	Weight (approx)			
S.N.	Description	Whether Conforms	Whether Deviates	Details/ Deviation/ Additional Features/ Remarks
<b>B</b>	<b>Specific Particulars</b>			
1.	Standards (Clause 2.0)	<input type="checkbox"/>	<input type="checkbox"/>	

	Give Details.			
2.	ABT Specific Requirements (Clause 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
3.	Power Quantity Measurements Requirements (Clause 4.0)	<input type="checkbox"/>	<input type="checkbox"/>	
4.	Other Power Quantity Measurements Requirements (Clause 4.0)	<input type="checkbox"/>	<input type="checkbox"/>	
5.	Meter Display (Clause 5.0)	<input type="checkbox"/>	<input type="checkbox"/>	
6.	Data Storage Requirements/ Meter Storage Capacity (Clause 6.0)	<input type="checkbox"/>	<input type="checkbox"/>	
7.	Monitoring of Voltages (Clause 7.0)	<input type="checkbox"/>	<input type="checkbox"/>	
8.	Special Power Quantity Measurement/ Display/ Storage/ Protection requirements (Clause 8.0)	<input type="checkbox"/>	<input type="checkbox"/>	
9.	Climatic conditions (Clause 9.0)	<input type="checkbox"/>	<input type="checkbox"/>	
10.	A.C. Supply System (Clause 10.0)	<input type="checkbox"/>	<input type="checkbox"/>	
11.	Test Output (Clause 11.0)	<input type="checkbox"/>	<input type="checkbox"/>	
12.	Self Diagnostic Feature (Clause 12.0) Provide Details.	<input type="checkbox"/>	<input type="checkbox"/>	
13.	Meter Power Supply Arrangement (Clause 13.0)	<input type="checkbox"/>	<input type="checkbox"/>	
14.	Clock Battery & Internal/External Power Pack Battery (Clause 14.0)	<input type="checkbox"/>	<input type="checkbox"/>	
15.	Real Time Clock (Clause 15.0)	<input type="checkbox"/>	<input type="checkbox"/>	
16.	Programmable Parameters (Clause 16.0) Give details of a) Factory Programmable b) User Programmable c) Any other	<input type="checkbox"/>	<input type="checkbox"/>	
17.	Communication Capabilities (Clause 17.0)	<input type="checkbox"/>	<input type="checkbox"/>	
18.	DCD/ CMRI & PC Software (Clause 18.0)	<input type="checkbox"/>	<input type="checkbox"/>	
19.	Sealing of Meter (Clause 19.0)	<input type="checkbox"/>	<input type="checkbox"/>	

20.	Meter Construction (Clause 20.0)	<input type="checkbox"/>	<input type="checkbox"/>	
21.	Metering Cubicle (Clause 21.0)	<input type="checkbox"/>	<input type="checkbox"/>	
22.	Connection Diagram & Terminal Marking (Clause 22.0)	<input type="checkbox"/>	<input type="checkbox"/>	
23.	Quality Assurance (Clause 23.0)	<input type="checkbox"/>	<input type="checkbox"/>	
24.	Type / Routine Tests (Clause 24.0) Enclose the latest type test certificates.	<input type="checkbox"/>	<input type="checkbox"/>	
25.	Acceptance Testing (Clause 25.0)	<input type="checkbox"/>	<input type="checkbox"/>	
26.	Manuals (Clause 26.0)	<input type="checkbox"/>	<input type="checkbox"/>	
27.	Warranty (Clause 27.0)	<input type="checkbox"/>	<input type="checkbox"/>	
28.	Packing (Clause 28.0)	<input type="checkbox"/>	<input type="checkbox"/>	
29.	Tamper, Fraud, Anomaly Detection/ Logging of Incidents (Clause 29.0)	<input type="checkbox"/>	<input type="checkbox"/>	
30.	Meter Identification/ Name Plate Details/ Marking of Meter (Clause 30.0)	<input type="checkbox"/>	<input type="checkbox"/>	
31.	Disclosure requirements (Clause 31.0)	<input type="checkbox"/>	<input type="checkbox"/>	
32.	Whether Optical Port Compatible with the DCD/ CMRI already existing with PSEB	<input type="checkbox"/>	<input type="checkbox"/>	
33.	Provide following details for DCD/CMRI a) Parameters read out b) Clock synchronization c) Per Meter downloading time and uploading time for PC d) Programmable parameters	<input type="checkbox"/>	<input type="checkbox"/>	
34.	Whether Meter is DLMS Compliant as per draft BIS companion standard (If not how the meter can be integrated with the proposed DLMS compliant remote centralized control centre). Provide details.	<input type="checkbox"/>	<input type="checkbox"/>	
35.	Any Additional feature / information	<input type="checkbox"/>	<input type="checkbox"/>	

1. This is certified that the above information is accurate & correct. There is no other deviation in the offered meters than those which are specifically mentioned above.



2. This is certified that in case the offered meters are not compatible with existing DCD/ CMRI/ HHU already available with PSEB, then the firm shall give 10 Nos suitable DCD/ CMRI/ HHU along with the data downloading software for BCS free of cost to PSEB for meter reading purpose. However cost of this DCD/ CMRI/ HHU is Rs. \_\_\_\_\_ in case PSEB wants to buy more of these units from the firm.
3. Further it is certified that meters have suitable number of communication ports meeting the specification requirements for online & offline Remote data communication purpose. The firm understands that CEA has already advised the Indian utilities to procure energy meters as per draft Indian Companion Standard (equivalent to IEC 62056 & DLMS Compliant) vide CEA letter no 502/6/2010-DP&D Dated 25.01.2010. In case the offered meters is not compliant to the draft/ final Indian Companion Standard, at the time of purchase by the PSEB's customer, then the firm supplies these meters to PSEB's customers with the firm commitment to make these supplied meters compatible to the above finalized BIS standard, may be through change of meter firmware at site etc. Otherwise the firm commits to supply free of cost the H/W protocol converter for meter end, suitable APIs for Control center end along with Details of Memory map, Protocol, technical support etc for the supplied meters to the concerned so that it may be possible to integrate these meters with proposed Remote Centralized Control Center in PSEB, which may be based upon/ suitable to the proposed BIS Companion Standards of DLMS/ COSEM (IEC 62056-21) etc.
4. This is certified that firm will supply the meters at the quoted price to the customers of PSEB along with applicable taxes & levies as approved by PSEB against this EOI. Any refusal to sell the meters to the customers of PSEB at the approved price will make the firm liable for penal action as may seem appropriate to PSEB.

Signature of authorized person:  
(Copy of the authorization is enclosed)  
Name:  
Designation:

Date:

Seal of Company