

**TECHNICAL SPECIFICATION FOR A.C.  
THREE PHASE FOUR WIRE L.T TRI-  
VECTOR ENERGY METER OF -/5 AMP  
OF ACCURACY CLASS-0.5S CT  
OPERATED FULLY STATIC AMR  
COMPATIBLE, 'CATEGORY-C'**

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(AS PER IS: 15959)**

**1.0 SCOPE:-**

This specification covers the manufacture, testing and supply of C.T operated Three Phase, Four Wire, L.T. Trivector Meters of accuracy class -0.5s with TOD (Time of day) and RTC (Real Time Clock) provisions and performing functions as tariff meters and for energy audit and load survey applications. These meters shall be capable of measurement and recording with Class 0.5s of Active Energy (kWh), Reactive Energy (kVAhH) and Apparent Energy (kVAh) for balance/unbalanced load at all power factors i.e. zero lag-unity-zero lead.

**2.0 STANDARD:-**

The meters with accuracy class -0.5s are required for measurement of active energy and shall conform to the latest edition of following standards-

IEC 62052-11	:	Electricity metering equipment (AC) – General requirements, tests and test conditions, Metering equipment
IEC 62053-22:	:	Static meters for active energy, (classes 0.2 S and 0.5 S)
CBIP 304:	:	Standardization of AC Static Electrical Energy Meters, publication no. 304
IS:14697:1999 read with latest revision thereof	:	Indian Standard, AC Static Transformer Operated Watthour and Varhour meters, classes 0.2 S and 0.5 S
IS 15959	:	Data exchange for electricity meter reading, tariff and load control - Indian Companion Standard

**3.0 CLIMATIC CONDITIONS:**

The meter shall be required to operate satisfactorily and continuously with specified accuracy under hot, dusty and tropical conditions and other climatic condition specified as here in after:-

(i)	Specified operating range	-10° C to +55°C
(ii)	Limit range of operation	-20° C to +60°C
(iii)	Limit range of storage and transport	-25° C to +70°C

(iv)	<b>Relative humidity</b>	
(a)	Annual mean	<75%
(b)	For 30 day(spread over one year)	<95%
(c)	Occasionally on other days	100%
(v)	Maximum attitude above M.S.L.	1000 m
(vi)	Average Annual rain fall	1200 mm

#### 4.0 CURRENT AND VOLTAGE RATING:-

The rated basic and maximum current of offered LT static tri-vector meters shall be as given below:

Sr. No	Voltage	Basic current	Maximum current(A)	Rated voltage (Phase to Phase)
01	415 V (phase to phase) & 240 V (phase to neutral)	5 Amp	200% times Ib	415 V (phase to phase) & 240 V (phase to neutral)

#### 5.0 VARIATION IN POWER SUPPLY:-

The meter shall be suitable for working satisfactorily with the following power supply system variations:-

##### 5.1 VOLTAGE RANGE:

- 1) Specified operating range: 0.8 to 1.1 V ref
- 2) Limit range of operation: 0.7 to 1.2 V ref .i.e. -30% to +20%

The meter shall be able to perform without any change in accuracy class with in the specified voltage range and shall also be within limits as prescribed in CBIP report no 304.

##### 5.2 FREQUENCY VARIATION:

The standard reference frequency for performance of the meter shall be 50 Hz with tolerance +/-5% of rated frequency as CBIP report no. 304.

#### 6.0 POWER CONSUMPTION:

##### 6.1 VOLTAGE CIRCUIT:

The active and apparent power consumption in each voltage circuit of the meter at reference voltage, reference temperature and reference frequency shall not exceed 1.0 watt/phase and 4VA per phase.

##### 6.2 CURRENT CIRCUIT:

The apparent power taken by each current circuit at basic current, reference frequency and reference temperature shall not exceed 1.0 VA per phase.

The above figure are mean values.

#### 7.0 POWER FACTOR RANGE:

The meter shall be suitable for Power factor range Zero-lag-Unit-Zero-Lead.

Apparent Energy shall be computed considering reactive ( lag + lead )

$$\text{i.e. Apparent Energy} = \sqrt{[\text{Active Import Energy}]^2 + [\text{Reactive Energy (Lag + Lead)}]^2}$$

## **8.0 STARTING CURRENT:**

The meter should start registering the energy at 0.1% of  $I_b$ .

## **9.0 ACCURACY:**

Class of accuracy of meter shall be 0.5S and shall confirm to accuracy requirement as per specify IS/IEC.

## **10.0 CALIBRATION AND TEST OUTPUT:**

The meter shall be have a test output accessible from the front and capable of being monitored with suitable testing equipment. The operation indicator, must be visible from front. However, it shall be possible to check the accuracy of energy measurement of the meter in the field by means of LED output on meter. Meter should have one / two calibration LEDs for accuracy measurement for different energies. Out of these, one should be kept fixed on kWh and other one shall be configurable for rest two (kVArh, kVAh). Resolution of the test output shall be sufficient to enable the starting current test in less than 10 minutes.

## **11. DISPLAY OF MEASURED VALUE:**

The meter shall be capable of measuring accurately under balanced and unbalanced conditions at all Power Factors:

- |      |  |   |       |
|------|--|---|-------|
| (1)  | The real time and date   | : |       |
| (2)  | Battery status   | : |       |
| (3)  | Active Energy  | : | KWH   |
| (4)  | Active Energy during specified T.O.D. hours.                                     | : | KWH   |
| (5)  | Reactive Energy  | : | KVARH |
| (6)  | Apparent Energy  | : | KVAH  |
| (7)  | Apparent Energy during specified T.O.D. hours                                    | : | KVAH  |
| (8)  | Max. demand with date and time with 30 minutes integration period.               | : | KVA   |
| (9)  | Cumulative Max. Demand   | : | KVA   |
| (10) | Max. Demand reset count.   | : | Nos.  |
| (11) | Average P.F. for a specified period  | : | P.F.  |
| (12) | Frequency  | : | Hz.   |
| (13) | Tamper and fraud details such as type of tamper, its duration and tamper-counts. | : |       |

### **11.1 DISPLAY PARAMETERS & TYPE OF DISPLAY:**

Meter shall be capable of displaying above parameters in the following sequence within specified limits of errors for balanced or unbalanced load at all P.F. as mentioned hereinafter:—

#### **a) Auto Display Mode:**

The meter shall be capable of recording and displaying automatically following data in order

1. Lamp Test
2. Real time

3. Date
4. Meter Serial Number
5. Current Active forwarded energy
6. Current Apparent forwarded Energy
7. Last Bill Active forwarded energy
8. Last Bill Apparent forwarded Energy
9. Current Month Max. Demand Active Forwarded
10. Current Month Max. Demand Apparent Forwarded
11. Last Bill Max. Demand in Active Forwarded (kW-Forwarded)
12. Last Bill Max. Demand in Apparent Forwarded (kVA –Forwarded)
13. Cumulative Max. Demand Active Forwarded
14. Cumulative Max. Demand Apparent Forwarded
15. MD reset count
16. Current TOD wise Active Energy forwarded
17. Current TOD wise Apparent Energy forwarded
18. Instantaneous Phase to Neutral Voltages ( R,Y,B)
19. Instantaneous Line Currents (Amps.)
20. Instantaneous Power factor with sign for lag/lead
21. Supply Frequency.
22. Instantaneous Load Active
23. Instantaneous Load Apparent
24. Total Tamper occurrence events count
25. Cumulative Power-On hours
26. Cumulative Power off hours

**b) Push Button Mode:**

The following parameters shall be displayed on pressing the push button(s):

1. Display Test
2. Real Time
3. Date
4. Meter Serial Number
5. Active forwarded energy
6. Reactive forwarded energy (Lag)
7. Reactive forwarded energy (Lead)
8. Apparent forwarded energy
9. Last Bill Active forwarded energy
10. Last Bill Apparent forwarded Energy
11. Current Max. Demand in Active Forwarded (kW-Forwarded)
12. Current Max. Demand in Apparent Forwarded (kVA –Forwarded)
13. Last Bill Max. Demand in Active Forwarded (kW-Forwarded)
14. Last Bill Max. Demand in Apparent Forwarded (kVA –Forwarded)
15. Cumulative Max. Demand Active Forwarded
16. Cumulative Max. Demand Apparent Forwarded
17. MD reset count
18. Current TOD wise Active Energy forwarded

19. Current TOD wise Apparent Energy forwarded
20. Instantaneous Phase to Neutral Voltages ( R,Y,B)
21. Instantaneous Line Currents (Amps.)
22. Instantaneous Power factor with sign for lag/lead
23. Supply Frequency.
24. Instantaneous Load Active
25. Instantaneous Load Apparent
26. Present PT Status
27. Present CT status
28. Present other status
29. Latest Occurrence of Tamper with date & time
30. Latest Restoration of Tamper with date & time
31. Total Tamper occurrence event count
32. High resolution active forwarded energy
33. High resolution apparent forwarded energy
34. Connection Check

Parameter value with relevant OBIS code should be made available on display.

Meter should be supplied with Backlit LCD display the measured value(s) shall be displayed on seven segments, seven digit liquid crystal Display (LCD) display unit/register having minimum character height of 10mm. The data should be stored in non volatile memory and should retain data for a period of not less than 10 (Ten) years under un-powered condition. Battery backup memory will not be considered as NVM.

Meter shall have feature of connection check i.e. PT missing, CT reversal on meter display itself. PT missing & CT reversal shall be checked from looking on meter display.

Meter shall have the facility to lock any parameter on display screen i.e. Scroll lock facility.

The display of various parameters shall be continuously scrolling one after another. The display shall have ON time of at least 6 seconds for each measured value for auto-display cycling. The meter should have facility for a manual mode where the parameters can be read by push-button mode should have priority over auto display.

The meter should have non-volatile memory, so that the registered parameters will not be affected by loss of power. The battery backup memory will not be considered as Non Volatile memory.

It should be possible to easily identify the single or multiple displayed parameters through symbols/legend on the meter display itself or through display annunciator.

The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

## **12. SPECIAL REQUIREMENT FOR DISPLAY:**

The meter shall have indication for unsatisfactory/non-functioning of the following:—

1. Time and calendar

- b) Real time clock with battery
- c) All display segments
- d) Non-volatile memory.

The meter serial number, C.T. and P.T. ratio and date with time of taking reading shall invariable be available at base computer software.

The meter shall be factory programmed for each and every month for minimum 20 years at the time of manufacture and correctness of 20 years calendar. In addition following parameters should also be factory programmed:—

- a) CT/PT Ratio
- b) Integration period
- c) Display sequence

The meter shall have provision to be read through communication port in the absence of power through an external source. An inductive coupling arrangement shall be provided so that it should not be possible to damage the circuitry of the meter by applying excess voltage directly in the meter. The meter should be powered up using an external battery pack only in absence of power supply to the meter to enable taking of meter readings through display and optical communication port.

If any bidder proposes for Internal Battery backup in the meter in case of mains supply failure for meter reading and meter data downloading, no power shall be consumed for this circuit when mains are available to recharge the battery.

In case of power failure data downloading for Historical energy, maximum Demand & all the tamper events through CMRI (common meter reading instrument) shall be possible through battery internal/ external backup. Rechargeable capacitor back up power shall not be used for display under Power absence condition. To verify that the sample meters are not having capacitor rechargeable battery, the samples will be kept in power off conditions for 7 days (168 hrs.) and then meters will be checked by pressing the push button and the CMRI shall be done.”

While installing the meter, it shall be possible to check the correctness of the C.T. & P.T. connections to the meter and their polarity with the help of common meter reading instrument.

The meter and related instruments, when installed, shall be constructed in a way offering full protection against contact voltage, other hazards resulting from/or related to the operating principle and the utilization of the equipment. In particular if any metal part accessible while covers are in place, then the base shall be fitted with protective Earth terminal identified by the Earthing symbol  $\perp$  and connected to all accessible metal parts.

The Static Tri vector Meter shall measure and retain previous 12 months data (month wise) of the KWH and KVAH reading at 2400 Hrs. of the last day of each calendar months, Average Power Factor and maximum demand with date and time of occurrence of that particular month for all specified time zones. These parameters shall also be obtainable through common meter reading instrument whenever required of last 12 months

The meter should remain powered up and functional even when either of any two phases or any one phase along with neutral is available to the meter.

The meter shall be provided with an accurate quartz crystal based real time clock. The maximum drift permissible in the real time clock shall be  $\pm 5$  minutes per year for class 0.5S Meters.

All the registers and other parameters shall be updated every second.

The meter should work accurately irrespective of phase sequence of the mains supply only in forward direction

The meter should continue to record satisfactorily as per prevailing electrical conditions even if the neutral of potential supply gets disconnected.

The meter shall record active energy in forward direction even if one or more CT's are reversed.

The current vector direction shall always be considered as positive (import) for the computation of 3 Phase active energy which shall be added in the main active energy forwarded register.

Mid night snap shot is required for configured energy (Apparent, Active, Reactive Lag and Reactive Lead) for last 35 days.

**13. MAXIMUM DEMAND (MD) REGISTRATION:**

The meter shall continuously monitor and calculate the average maximum demand for each interval of time of 30 minutes and maximum of these shall be stored along with date and time when it occurred.

The meter shall automatically store the 30 minute average demand. At the end of every 30 minutes, the new calculated demand should be compared with previous maximum demand and stored whichever of them is higher. The maximum demand for every calendar month along with the date and time when it occurred should be registered.

The maximum demand shall automatically reset at 24.00 Hrs. of the last date of each calendar Month for which minimum 20 calendar years shall be programmed by the manufacturer at his work.

The meter shall be provided with its own real time clock calendar with built in battery backup and time derived from this clock shall be used for maximum demand intervals. The meter shall display the maximum demand reset count.

**14. LOAD SURVEY REQUIREMENTS:**

The meter shall be capable of recording following parameter for 35 days with 30 minute integration period.

- Active forwarded (Kwh)
- Apparent forwarded (KVah)
- Reactive forwarded Lag (KVarh lag)
- Reactive forwarded Lead (KVarh lead)



- Phase Voltage (V1, V2, V3)
- Phase Current (Ir,Iy,Ib)

The meter shall have test output device accessible from the front and capable of being read with suitable testing equipment. The output device may be either in the form of pulses or in the form of high resolution display.

The meter shall be possible to select either demand or energy view at the BCS end. The above load survey data should be available in the form of bar charts as well as in spreadsheets. The BCS shall have the facility to give complete load survey data both in numeric and graphic form.

The load survey data, abnormality event information and instantaneous parameters data shall all be retrievable through the meter's communication port and RJ 11 port through a common meter reading instrument (CMRI)/ Hand Held Unit/ Modem and shall be transferred (downloaded) to a PC with Windows based software to get complete details in numerical and/or graphic form. The necessary base computer software (BCS) for this purpose shall be provided by the supplier with complete details.

The meter shall be capable of storing KVA demands at 30 minutes interval for a minimum of last 35 days. The maximum demand in last 12 months with date and time of occurrence and tamper details as per clause 24.0 in its non-volatile memory and it shall be possible to transfer this data via a galvanically isolated optical communications port on to a base computer station through a Window/ DOS based CMRI or remotely using the remote communication interface as and when desired. Load profiles can be viewed graphically/ analytically with the help of meter application software. The offered meter application software shall be capable of exporting these data for analysis to other user software in spreadsheet format (XML/Excel etc.).

## 15. TIME OF DAY (TOD) TARRIF:

- 15.1 Meter shall be able to record and store apparent and active energies, consumption along with maximum demand in KVA during specific peak hours described as following time Zone of register in sequence:—

Meter TOD Zone	
Time Slots	Hours of Day
1	17-18
2	18-22
3	22-23
4	23-05
5	05-06
6	06-08
7	08-11
8	11-17

- 15.2 The running TOD zone should be available on display by push and auto mode for information purpose.
- 15.3 The meter shall have facility for recording and storing of TOD consumption and maximum demand data on minimum Three Tariff Rates, per day basic.
- 15.4 The Meter should have in-built capacity to define up to eight (8) time zones through operation of CMRI. The change of the TOD time-period(s) or changing number of TOD zones should be possible through CMRI with special authenticated command from the BCS so that only

authorized person(s) can make such changes. The main control of this system along with proper security password/ code should be available on one or more computers located at the authorized location(s) as per the directions given by the purchaser.

#### **16.0 COMMUNICATION CAPABILITY:**

The meter shall have facilities for data transfer locally through CMRI and remotely by GSM and GPRS modems/devices with proper security via an optically isolated communication port using serial communication. It should be possible to configure meter for TOD tariff demand integration period, billing date, real time clock and date etc. through CMRI locally without any extra cost to PVVNL, but the same shall be done by us only after taking due approval of MD, PVVNL or his authorized representative. The meters shall have a galvanically isolated optical communication ports as per IEC 1107 so that it can be easily reading instrument for data transfer. The meter shall have additional RJ11 port along with optical port for reading data through CMRI and AMR modem. Communication ports shall not be affected by any type of infection/unauthenticated signals. The baud rate should not be less than 9600 bps and higher baud rate shall be preferred for down loading the data. The complete data shall be downloaded within 5 minutes from meter to CMRI & from CMRI to BCS.

The bidder shall supply software required for local (CMRI) & remote (AMR) connectivity including required training to use the software free of cost. Both the communication ports may work simultaneously. The bidder shall provide meters as per DLMS compliance i.e. meters with open protocol as per IS: 15959 Category “C” for consumer metering.

**Separate communication cords for optical port and RJ11 port have to be supplied with each meter free of cost. There should be the provision of reading the data without opening the meter box.** Also the meter box shall have provision at the meter body. The bidder shall provide meters as per DLMS compliance i.e. meters with open protocol as per IS:15959 Category “C” for consumer metering.

#### **17.0 BASE COMPUTER SOFTWARE**

Software for reading, down loading data of the meter and TOD programming in the meter, normally resident in the Common Meter Reading Instrument (CMRI), software suitable for MS-DOS 5.0 or higher version.

Windows based Base Computer Software (BCS) for retrieving data from CMRI and downloading instructions from base computer software to CMRI. This BCS should have, amongst other requirements and features and facilities described later in this specification, the facility to convert meter reading data into XML/ ASCII file format so that it may be possible for the user to integrate the same with the user's billing data and process the selected data in desired manner.

Necessary software for loading application program via CMRI serial port.

The following software shall be made available and installed on CMRI & BCS by the firm whose meters are to interface with CMRI without any extra charges. Any future up gradation in both the software shall be provided free of cost.

- (a) Software to be resident in CMRI for the purpose of reading and programming the specific make(s) of static meters.
- (b) Base computer stations (BCS) software for accepting data for CMRI, processing generating reports and down loading instruction from the BCS to CMRI. The firm shall also provide XML/ASCII conversion utility along with BCS software for processing of the billing data.
- (c) The firm shall install the above software without any extra cost on call from one of the Test Division located in each of the Zones. The purchaser will arrange these software installations in rest of the existing and future Test Divisions for which necessary softcopies with appropriate licences shall be provided by the firm.
- (d) It should not be possible to re-program the meter at site (write facility through optical port) without authenticated password. The meter programming through optical port shall not be acceptable except time of day (TOD) and real time clock (RTC). Provision for programming of TOD and RTC shall necessarily be provided.
- (e) For efficient and speedy recovery of data read through CMRI, view & analysis, a Base Computer Software (BCS) shall have to be supplied having the following features:

The BCS software shall be windows based user friendly. The data transfer shall be highly reliable and fraud proof. Base Computer software shall give all details adequate for analysis and abnormal event data & load surveys parameters. The software shall have the facility to convert all the consolidated information / data of selectable parameters into ASCII format. EDP department of purchaser can generate its own DBF (data base files) to downloaded all the required information into it.

**i. Platform:**

The BCS shall be executable on MS WINDOWS XP or higher system. The BCS shall be suitable to run on IBM PC or compatible hardware platform.

**ii. Meter Data Display:**

The software shall show electrical condition existing at the time of reading the meter in tabular forms as well as graphical format (Phase diagram with phase angle).

All the information about energy, maximum demand and their respective TOD register reading, billing register readings shall be shown in a manner which user can easily understand.

All the load survey data shall be available in numerical as well as graphical format. It shall be possible to view this data daily, weekly, and monthly format. The load survey graph shall show values where the cursor is placed for the selected or for all parameter.

All the information about tamper events shall be accompanied with date and time stamping along with 'snap-shot' of respective electrical conditions. This information

shall be displayed in the sequence in which it happened in cumulative format as well as summary format.

BCS shall display Date and Time of Meter and meter Reading Instrument (MRI). The software shall be capable of preparing CMRI to read the meter information or time setting of the meter.

**iii. Support Display:**

There shall be "user friendly" approach for viewing meter data for the reading collected now or for the reading collected in the past. All information about a particular consumer shall be sorted out and available at one place so that locating any consumer's past data is easy. It shall be possible to retrieve/locate data on the basis of either one of the following particulars:

- a) Consumer's ID/Numbers.
- b) Meter Sr. No.
- c) Date of meter reading.
- d) Location.

BCS of the bidder should support the all supplied meters of its own make.

**iv. The Data Transfer:**

It shall be possible to transfer data to and fro from CMRI through serial interface.

**v. Configurability:**

It shall be possible to have selective printing out of all available data of the meter. Print out shall not include anything and everything available with the BCS. The software shall support "print wizard" whereby user can decide what to print out. The use of the software need not revert back to us for modifying the software just to print what he desires.

BCS shall have facility to export data to XML/ASCII or spreadsheet format for integrating with the purchaser's billing system. Here again an "Export wizard" or similar utility shall be available whereby user can select file format, what data to export, the field width selection etc.

**vi. Security:**

The BCS shall have multilevel password for data protection and security. The first level shall allow the user to enter the system. The different software features shall be protected by different passwords. The configurable of passwords shall be user definable. The software installed on one PC shall not be capable on another PC.

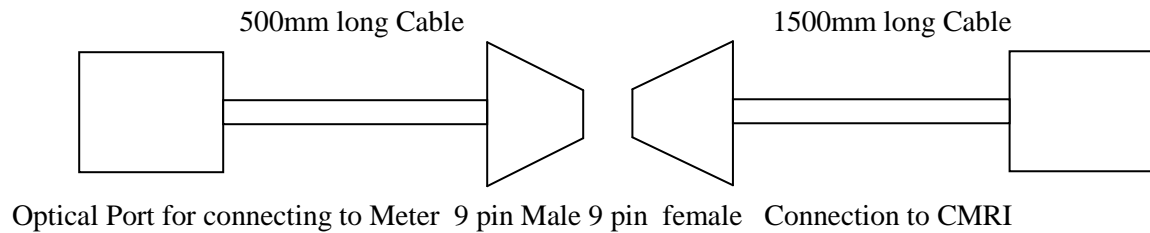
**vii. Help:**

The exhaustive help shall be available with the software so that user can use all the features of the software by just reading the help contents.

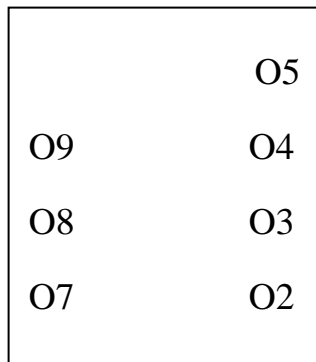
**INTERFACE WITH MS DOS BASED CMRI:**

For Physical interface between meter and Common Meter Reading Instruments shall consist of meters optical sensor terminating into a 9 Pin D type male connector with a cable of 500mm + 10mm length with a provision of reading the data without opening the meter box.

### **ILLUSTRATION NO.1**



The configuration of 9 Pin D type male connector shall be as given below:



PIN SIGNAL NAME	
01	NC
02	TRANSMIT DATA (TXD)
03	RECEIVE DATA (RXD)
04	NC
05	SIGNAL GROUND (SG)
06	NC
07	NC
08	NC
09	POWER SUPPLY

### **ILLUSTRATION NO.2**



### **17.0 GENERAL REQUIRMEENTS:**

- 17.1 Meter shall be designed and constructed in such a way as to avoid introducing any danger in use and under normal conditions so as to ensure specially the following:—
1. Personnel safety against electric shock
  2. Personnel safety against effects of excessive temperature.
  3. Protection against penetration of solid objects, dust and water.
  4. Protection against spread of fire.
  5. Detection against fraud or pilferage.

There should not be any screws in the meter body through which meter can be opened and tampered without breaking the seal.

- 17.2 All the material used in the manufacture of meters shall be of highest quality. The entire design and construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation.

- 17.3 All insulating material used in the construction of meter shall be non-hygroscopic non ageing and of tested quality and will conform to tests as specified in relevant Standards. The meter shall be designed on application specific integrated circuit and shall be manufactured using SMT (Surface Mount Technology) components.
- 17.4 The terminal block, the terminal cover and the meter case shall ensure reasonable safety against the spread of fire. They should not be ignited by thermic overload of live parts in contact with them.
- 17.5 The meter shall have seamless ultrasonically welded insulated body, along with unidirectional screws and wall mounted projected type to be fitted with the help of screws.
- 17.6 The meter shall conform to the degree of protection IP51 of IS:12063/IEC:529 for protection against ingress of dust, moisture and vermin.
- 17.7 All parts which are subject to corrosion under normal working conditions shall be protected effectively. Any protective coating shall neither be liable to change by ordinary handling nor damaged due to exposure to air under normal working conditions.
- 17.8 The meters shall be designed such that their working remain unaffected by electromagnetic interference, electrostatic discharges and high voltage transients as specified in CBIP Report No. 304.

## **18 CONSTRUCTIONAL REQUIREMENTS:**

### **18.1 METER CASE:**

The meter shall have completely ultrasonically seamless type welded ( in such a manner that it can not be opened without breakage or crack ) insulated body and be of wall mounted panel mounted projected type fitted with the help of screws. The meter case shall be made of unbreakable high grade fire resistant, high grade engineering plastic which is sealed in such a way that the internal parts of the meter are accessible only after breaking the meter cover seals. The meter cover shall be fixed permanently and shall not be removable without the use of a tool. The meter cover shall have two sealing unidirectional screws, each screw having a sealing hole. These screws shall be made of tin plated brass and capable of being tightened from front.

The meter case shall have three mounting holes. Two holes for mounting screws on the terminal block sealed beneath the terminal cover and one for hanging screws on the top.

The meter body shall have seamless ultrasonically welded insulated body in such a way so that meter body cannot be opened without breaking the body of meter.

### **18.2 WINDOW:**

The meter cover shall be of high grade, fire resistant, high grade engineering plastic with one window made of UV stabilized, poly-carbonate plastic for reading the register and observation of operation indicator. The window shall be of a transparent material ultrasonically welded with the meter cover such that it cannot be removed undamaged without breaking the meter cover seals.

### **18.3 TERMINALS AND TERMINALS BLOCK:**

The base of the meter shall have a terminal block at the bottom made out of high grade engineering plastic so as to facilitate bottom connection and houses solid nickel plated brass terminals having capability to carry maximum value of current.

The material of the terminal block shall be capable of passing the tests given in IS 14697: 1999/ CBIP -304.

The terminal holes in the insulating material shall be of sufficient size to accommodate the insulation of the conductors. The diameter of the terminal hole for current terminals shall not be less than 5.0 mm & shall be of adequate length in order to have proper grip of conductors / crimping pins with the help of two screws.

The terminal block shall satisfy all the conditions such as clearance & creepage distance between terminals & surrounding part of the meter as specified in relevant clause of IS 14697: 1999/ CBIP-304.

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact such that there shall have no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimised. Electrical connections shall be so designed that contact pressure shall not be transmitted through insulating material.

### **18.4 TERMINAL COVER:**

The terminals block cover for the energy meters shall be extended transparent type, which can be sealed independently of the meter cover. The ETBC shall have a clear space of min  $40 \pm 5$ mm, thus allowing sufficient clearance space for inserting cables. ETBC shall have a top side hinge arrangement for easy access of terminal for wire termination. The terminals, their fixing screws and the insulated compartment housing them shall be enclosed by extended terminal cover in such a way that no part of meter or accessories at terminal block shall be accessible from the front of the meter. There shall be provision of fixing of seals so that screws cannot be loosened without breaking the seals.

The terminals shall not be accessible without removing the seal(s) of terminal cover when energy meter is mounted on the meter board.

The terminal cover shall have two sealing screws independent of each other. The fixing screws used on the terminal cover for fixing and sealing shall be kept captive in the terminal cover.

### **18.5 TERMINAL ARRANGEMENT:**

The terminal shall be marked properly on terminal block for giving external connection diagram of connections should be provided inside the cover of terminal block. The terminal cover shall be extended such that when it is placed in position it is not possible to approach the connections or connecting wires.

#### **19.0 OUT PUT DEVICE:**

The meter shall have a test output accessible from the front and be capable of being monitored with suitable testing equipment. The operation indicator shall be visible from the front. Common Test output device shall be provided in the form of LED output device. The relation between test output and the indication on display shall comply with the marking on the name plate (imp per kWh).

#### **20.0 CONNECTION DIAGRAM:**

Every meter shall be indelibly marked with connection diagram showing the phase sequence for which it is intended and shall be attached to the inner-side of the extended terminal block cover. In case of any special precautions need to be taken at the time of testing the meter, the same may be indicated along with the circuit diagram. The terminal cover shall be extended such that when it is placed in position it is not possible to approach the connections or connecting wires.

#### **21.0 SEALING OF METER:**

Meter cover should be physically joined by seamless ultrasonic welding in such a way that meter cover cannot be opened without breaking and shall be physically evident as well as it should be logged as tamper event in case cover is opened. Reliable sealing arrangement should be provided to make the meter tamper evidence and avoid fiddling or tampering by unauthorized persons by way of providing at least two Nos. seals on meter body, two No. seal on meter terminal cover and one No. seal on MD reset button (if such button is provided) shall be provided. All the seals should be provided on front side only. Rear side sealing arrangement shall not be preferred.

#### **22.0 Name Plate MARKING OF METER:**

Every meter shall be provided with a name-plate which shall be clearly marked/embossed as per clause-7 of IS:14697/1999. The name plate shall have following markings which shall be indelible, distinct and readable from outside the meter:—

- (a) Purchaser's name, Purchase order No. and date with inscriptions or "PROPERTY OF PVVNL".
- (b) Manufacturers name, Trade mark and place of manufacturer.
- (c) Design & type.
- (d) Nature of current and no. of phases and no. of wires for which meter is suitable for.
- (e) The manufacturers serial no., year of manufacture and warranty period. The serial no. is also to be marked on the meter base.
- (f) Reference voltage
- (g) Reference current
- (h) Meter constant (if any)
- (i) Class of accuracy
- (j) Reference temperature
- (k) Transformation ratios of instrument transformers (s) of which account is taken for meter constant.



### 23.0 METER SERIAL NUMBER:

In addition to providing serial number of the meter on the display plate, the meter serial number shall also be programmed into meter memory for identification through CMRI/meter reading print out.

### 24. TAMPER AND FRAUD PROTECTION:

The meter should have facility to detect the occurrence and restoration with date and time of at least the following common ways of tamper and frauds. The meter shall also have the facility to indicate/log at BCS end snap shot of parameters i.e. voltage of all Phases, Current of all phases, P.F. of all phases, KWH & KVAH on occurrence and restoration of tamper.

The meter should have following anti tamper features to monitor and detect common ways of tamper and fraud.

- a) **Missing Potential:** The meter shall be capable of detecting and recording occurrences and restoration of missing potential (one phase/two phases) which can happen due to intentional / accidental disconnection of potential leads.
- b) **Current Polarity Reversal:** The meter shall be capable of detecting and recording occurrences and restoration of current polarity reversal of one or more phases which can be happen due to wrong connection of current leads. The meter shall continue to record energy in forwarded direction even in case of CT reversal.
- c) **Current Circuit Short/ Bypass:** The meter shall be capable of detecting and recording occurrences and restoration of shorting of any one or two phases of current circuit at the meter. Event detection logic should be capable of discriminating the system abnormalities form source side and load side and it should not log /record event due to source side abnormalities.
- b) **Current Circuit Open:** The meter shall be capable of detecting and recording occurrences and restoration of opening of any one or two phases of current circuit which can happen due to intentional / accidental disconnection of current circuits. No load condition should record in meter memory as a Current circuit open event.
- c) **Current Unbalance:** The meter shall be capable of detecting and recording occurrences and restoration of current unbalance as an event. The above information should be possible to download from the meter through hand held unit and available at BCS end. The current unbalance more than 30 % should be recorded as an event in the meter memory.
- d) **Voltage Unbalance:** The meter shall be capable of detecting and recording occurrences and restoration of voltage unbalance as an event. The above information should be possible to download from the meter through hand held unit and available at BCS end.

- e) **Invalid Voltage:** The meter should be capable of recording occurrences of invalid voltage. Invalid voltage is checked if a single phase voltage is looped into the two remaining voltage inputs on the meter.

**f) INFLUENCE OF HIGH MAGNETIC FIELD:**

The performance of meter should not be affected under the influence of external DC/AC magnetic field of high intensity as mentioned in CBIP Technical Report-304 Meter shall start recording fast energy at I<sub>max</sub> in case of placement of magnet on any part of meters body i.e. front or back or top or bottom etc as per the latest amendment of CBIP '304.

- g) **Cover Open tamper:** Logging of cover open tamper through tamper switch placed inside the meter and shall communicate signal to display LCD as well recorded in memory of MRI. Separate legend for cover open event shall be made available on LCD. This legend shall remain in on state till meter reading so that it will come in to notice of meter reader.

**h) ABNORMAL VOLTAGE/FREQUENCY DEVICE TEST:**

The accuracy of the meter would not be affected with the application of abnormal voltage/frequency generating device having spark discharge of approximately 35KV. The meter will be tested by feeding the output of this device to meter in any of the following manner for 10 minutes:

- i) On any of the phase or neutral terminals.
- ii) On any connecting wires of the meter.
- iii) Voltage discharge with 0-10 mm spark gap.
- iv) Spark on meter body.
- v) Spark on the optical and RS 232 port.
- vi) At any place in load circuit.

The accuracy of the meter will be checked before and after the application of above device.

- i) **Snap Shots:** The meter shall record three phase voltage, current, power factor separately with KWh and KVAh energy at the time of each tamper event after completion of persistence time of occurrence/ restoration ( except power on off) with the date and time of event. It shall be possible to retrieve the tamper data along with all related snap shots data through the meter's optical port with the help of CMRI and download the same to the BCS where it shall be available for viewing. All this information shall be available in simple and easily understandable format. In case the meter is immune to any of the above tampers and in such circumstances if snap shot is not logged, shall also be acceptable.
- j) **Power on/off:** The meter shall be capable to record power on /off events in the meter memory. All potential failure should record as power off event.

Minimum 300 events (including occurrence & restoration shall be counted as a separate event) of all types of tamper event with date and time shall be available in the meter memory on first-in, first-out basis. It shall be possible to retrieve the event data along- with all related snap- shots' data through the meter's optical port and through radio with the help of CMRI and download the same to the BCS where it shall be available for viewing. All this information shall be available in simple and easily understandable format.

#### **24.0 TAMPER INFORMATION/ LOGIC :**

The persistence time of logging of an occurrence of tamper shall be five minutes. The persistence time for logging of restoration of tamper shall be two minutes.

Once one or more compartments have become full, the last tamper event pertaining to the same compartment shall be entered and the earliest (first one) tamper event should disappear. Thus, in this manner each succeeding tamper event shall replace the earliest recorded event, compartment wise (first in first out basis). Events of one compartment/category should overwrite the events of their own compartment/category only. The firm should furnish the details as to how these meter is able to detect protect/record about tamper and fraud features with sketches and phaser diagram when ever necessary.

#### **NOTE:**

- a) The meter design should take care of all the possible tamper methods and the "Purchaser" will not accept the external arrangements like external box cover etc.
- ii) All the tamper features shall be tested in routine inspection of meters in each offered lot and shall be part of Routine/Acceptance test.
- iii) The tamper event recording shall be roll over type for each individual compartment. The latest/ last tamper event shall be logged and earliest event will disappear in each compartment. Tamper occurrence and restoration shall be counted as separate event.

#### **25.0 TAMPER PERSISTANCE TIME:**

The persistence time of logging of an occurrence of tamper shall be five minutes. The persistence time for logging of restoration of tamper shall be two minutes. Provision shall be made for logging voltage of all phases, current of all phases , power factor of all phases , KWH and KVAH on occurrence and restoration of tamper at BCS end..

#### **26.0 ELECTROMAGNETIC COMPATIBILITY AND INTERFERENCE REQUIREMENT:**

The meter shall meet EMI/EMC requirements as specified in the relevant standards.

Note: - As the meter shall read through Low Power Radio, Radiated & conducted emission test will not applicable to these meters.

#### **27.0 MINIMUM TESTING FACILITIES:**

The bidder must have the necessary minimum testing facilities for carrying out the following tests:

- I. AC voltage test
- II. Insulation resistance test

- III. Test of limits of errors
- IV. Test of meter constant
- V. Test of starting condition
- VI. Test of no load condition
- VII. Repeatability of error test
- VIII. Test of power consumption
- IX. Tamper conditions - as per our offer

### **30. DRAWING AND MANUAL**

- 30.1 The firm is required to submit one copy of drawing and manual with every lot of the supply in the form of CD.
- 30.2 Maintenance and repair manuals including instructions for testing adjustments and calibration shall be submitted with the contractual documents.

### **31.0 INSPECTION AND TESTING:**

- 31.1 Each lot of meters offered for supply shall be inspected for routine/ acceptance and anti tamper feature test at manufacturers' works to verify that these are being supplied in accordance with relevant standards/ technical specification and guaranteed technical particulars.
- 31.2 Inspection of material shall be carried out by the representatives of Superintending Engineer (Equator) PVVNL, Meerut.
- 31.3 While offering a lot for inspection/testing, confirmation to the effect that meter have successfully withstood to routine/ acceptance and anti tamper feature test, (Enclosing test results) alongwith packing list shall be submitted to Superintending Engineer (Equator), PVVNL, Meerut as well as to purchaser.

At the times of inspection and testing the firm shall however submit all routine test results of all meters offered, to the inspection officer.

- 31.4 All instruments used in inspection and testing should be properly calibrated and sealed once a year. Calibration Certificate when demanded by the inspecting officer shall be provided / produced for verification purposes. In case of any dispute regarding calibration, instruments shall be sealed and signed by the representative of the firm and purchaser and will be sent to test house Government lab/ Government Institution of repute, for calibration at the cost of firm.
- 31.5 Purchaser reserves the right to get the meters inspected/ tested before dispatch by any Independent Inspecting Agency, at the cost of purchaser.

### **32.0 TYPE TEST:**

#### **32.1 SCHEDULE OF TYPE TEST SHALL BE AS FOLLOWS:**

##### **32.1.1 TEST FOR MECHANICAL REQUIREMENTS:**

- (a) Spring hammer test
- (b) Protection against penetration of dust and water
- (c) Test of resistance of heat and fire

### **32.1.2 TEST FOR ELECTRICAL REQUIREMENT**

- (a) Test of power consumption
- (b) Test of influence of supply voltage
- (c) Test of influence of short time over currents
- (d) Test of influence of self heating
- (e) Test of influence of heating
- (f) Test of influence of immunity of earth fault

### **32.1.3 INFLUENCE OF INSULATION PROPERTIES:**

- (a) Impulse voltage test
- (b) AC High voltage test
- (c) Insulation test

### **32.1.4 TEST OF ELECTROMAGNETIC COMPATIBILITY:**

- (a) Radio interference measurement
- (b) Fast transient burst test
- (c) Test of immunity to electrostatic discharge
- (d) Test of immunity to electromagnetic H.F. field

### **32.1.5 TEST OF ACCURACY REQUIREMENT:**

- (a) Test of limits of error
- (b) Interpretation of test results
- (c) Test of meter constant
- (d) Test of starting conditions
- (e) Test of no load conditions
- (f) Test of ambient temperature influence
- (g) Test of repeatability of error
- (h) Test of influence quantities

### **32.1.6 TEST FOR CLIMATIC INFLUENCE**

- (a) Dry heat test
- (b) Cold test
- (c) Damp cyclic test

**Note:** Any other type test if included in IS/IEC/CBIP standard (latest revision) or test as per revised limits have to be done on PROTO-TYPE sample meter.

The firm shall supply the meter as per specification/drawing as type tested. If any change in the design/parameters is being made, then the meter shall have to be type tested again at the cost of the firm.

## **32.2 ROUTINE TEST:**

All the meters offered for supply shall be tested by the manufacturers at their works so as to conform that these are being manufactured in accordance with the technical specification/ISS. A copy of these routine test results shall be enclosed alongwith the packing list at the time of offering the material for inspection.

### **32.3 ACCEPTANCE TESTS:**

Shall consist of the following :

- (a) A.C. Voltage test
- (b) Insulation resistance test
- (c) Test on limits of errors
- (d) Test on meter constant
- (e) Test on starting condition
- (f) Test of no-load condition
- (g) Repeatability of error test
- (h) Test of power consumption
- (i) Vibration Test
- (j) Shock Test
- (k) Tamper proof test

### **33.0 OTHER GENERAL REQUIREMENT:**

- (a) The meter shall be designed in a way to ensure continuity of supply and reliability, providing facilities for inspection, testing and calibration, maintenance and repair. They shall operate without undue vibration and the least amount of noise.
  - (b) They must so designed to be unaffected by normal sea, air or land transport requiring no recalibration before, installation and routine or type tests.
  - (c) The frame supporting metering elements shall be unique, single piece sufficiently rigid.
- 34.0
- (a) Material shall be packed generally in accordance with clause 9.1 (Annexure-E) of ISS: 13010:1990.
  - (b) Accompanying devices and accessories shall be placed inside a shock absorbing, protective carton box or expanded polystyrene moulding. One carton box or expanded polystyrene moulding may be used to accommodate not more than five Nos. Energy Meters.
  - (c) The meters and devices in boxes or mouldings shall be carefully packed for overseas shipment in sturdy wooden cases capable to be stored outdoor without further protection against weather conditions (Rain or humidity).
  - (d) Meters in the original packing shall be unaffected by normal sea, air or land transport and should be ready to be installed and operate reliably and accurately immediately after unpacking.

### **35.0 SPARE PARTS:**

- (a) Availability of spare parts shall be guaranteed by the firm for a period of 10 years after the delivery of each item.
- (b) The firm or their collaborators or their authorised agents should have service facilities alongwith adequate spare parts in India to provide prompt service initially for a period of 10 years.

### **36.0 AFTER SALES SERVICE:**

After Sales Services, as and when required shall be provided by the firm to the purchaser directly through their own qualified Engineer and it will also be their responsibility to educate PVVNL

staff by demonstration and detailed technical instruction as mutually agreed upon at different sites (Zonal Headquarters) in the State of U.P. for 60 months from the date of last dispatch.

**37.0 TECHNICAL SPECIFICATION AND GUARANTEED TECHNICAL PARTICULARS:**

The material shall be manufactured and tested in accordance with specific requirement of this specifications of Static Trivector Meters and Guaranteed Technical Particulars (GTP).

**38.0 METHOD/PROGRAMME TO BE ADOPTED FOR LOADING OF METER**

**SOFTWARE PROGRAMME IN MS DOS BASED METER READING INSTRUMENTS:**

It shall be the responsibility of the supplier to load their software programme in MS Window/ DOS Based CMRI of any other make, on the Computer installed/to be installed in various office of PVVNL as per request received directly from field units or Purchaser without any extra charges.

The coordination for this purpose between supplier of MS Window/ DOS Based CMRI's and Static Trivector Meter respectively, shall be made by purchaser.

**39.0 PERIOD OF GUARANTY AND PERFORMANCE:**

- (a) The firm shall undertake a guarantee for 60 months from the date of installation and 66 months from the date of supply, replace within one month of receipt of report of the meters, which are found defective/ inoperative at the time of installation
- (b) In case of any discrepancy between the specification and relevant standards, provisions contained in this specification shall prevail.

**40.0 Sample Meters:**

Four no. sample meter of LTTVM trivector energy meter along with type test report must be submitted within 7 days of opening of Part-I. Sample meters of the firms meeting pre qualifying condition of the tender, shall be the tested at Third Party Govt. Lab decided by the Discom, as per technical specification and relevant IEC/IS in the presence of bidder and purchaser representatives at the cost of bidder. However place of testing is at the discretion of the purchaser. Date of testing will be informed to all bidders. Engineer of the bidder shall come with BCS and CMRI so that tamper information with date & time, load survey and meter readings could be downloaded by CMRI and printout could be taken to verify the internal features also. Part-II will be opened for only those bidders whose sample meters will pass in testing.

**GUARANTEED TECHNICAL PARTICULARS FOR LT TRIVECTOR ENERGY METER 3  
X 240 Volts, -/5 AMPS DLMS CAT C.**

S.N.	Particulars		Our comments
1	2		3
1	Maker's Name	:	
2	Make	:	
3	Type of Meter/Design designation	:	
4	State the year since the design is in vogue	:	
5	Standard to which meters conforms	:	
6	Class of accuracy	:	
7	Rated Current (Amp)	:	
8	Rated Maximum current as percentage of basic current	:	
9	Rated voltage (volts)	:	
10	Rated frequency (Hz)	:	
11	Specified operating voltage range	:	
12	Limit voltage range of operation	:	
13	Reference temperature	:	
14	Temperature range of operation: a. Specified operation range b. Limit range of operation c. Limit range for storage and transport	: : :	
15	Relative humidity:  a) Annual mean b) For 30 days these days being spread in a natural manner over the years. c) Occasionally on other days	: : :	



16	Power consumption  a) Power consumption in voltage circuit at rated current  (i) Active in watts (ii) Apparent in VA. b) Power consumption in current (in VA) at rated current	:  :  :  :	
17	Current that meter is capable of carrying continuously without injury to the meter (Amp.)	:	
18	Short time over current capability of the meter	:	
19	Percentage minimum current which will start the meter and continue to run thereafter at rated voltage and unit power factor of basic current (% of basic current)	:	
20	Type of material along with its thickness or dimensions (in mm.) and details of the important components parts of the meter  a) Case b) Terminals covers c) Terminals	:  :	
21	a) Size of terminals holes (in mm.) b) Whether Display Character Height is 10 mm , specify Height in mm.	:	
22	No. of earthing terminals provided on the body of the meter, if any	:	
23	Whether toughened glass window is provided.	:	
24	a) Whether carrying handle is provided b) Whether arrangement to read the meter in Power Off mode.		
25	Meter constant (if any)	:	
26	Tamper & Fraud Protection details State whether as per specification cl no. 24 or not?  a) Missing potential b) Current Reversal c) CT Short/ Bypass d) Current Circuit Open	:  :  :  :	



33	Overall dimensions of the meter (with tolerance)  (a) Height (mm) (b) Width (mm) (c) Depth (mm)	:   :	
34	Total weight of the meter (kg.) with tolerance	:	
35	Reference of I.S.I certification License, if any		
36	State whether –  (a) Load survey capabilities of 35 days have been provided as per clause 14 of technical specification. (b) Time of day zones have been provided as per clause 15 of technical specification	:  :	
37	STATE WHETHER:-  a) The offered meter has been type tested within last three years or not? b) The similar of higher size meters have been type tested within last three years or not? c) If yes, then complete type test report has been enclosed with Tender Bid-I.		