


# **TECHNICAL SPECIFICATIONS FOR ENERGY METERS**

*HT AC 3 PHASE 4 WIRE, CT / PT OPERATED, 1 AMP or 5 AMPS (As specified by the purchaser) BI-DIRECTIONAL ELECTRONIC TRI-VECTOR METER OF ACCURACY CLASS 0.2S, WITH ABT, TOD FACILITY AND DLMS ICS COMPLIANT SUITABLE FOR 11KV FEEDERS /Bulk consumers & INTER UTILITY POINTS.*

  
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## 1.0 SCOPE

1.1 This specification covers design, manufacture, inspection, testing before despatch, Supply & delivery of HT AC 3 phase 4 wire, CT / PT operated, 1 Amp or 5 Amps (As specified by the Purchaser), bi-directional electronic tri-vector meter of accuracy class 0.2S both for active and reactive energy capable of measuring electrical energy & demand in balanced and/ or unbalanced loads & load survey for energy audit. The meters shall be used for 11 KV Feeders/inter utility power flows / bulk consumers with Availability Based Tariff (ABT) and TOD facilities. The meter shall comply with DLMS Indian Companion Specification (ICS) for **Category A and B**.

- 1) Supplying, wiring, & replacement of existing 11 kV feeder meters and 3phase 3 wire TTBs by DLMS meters with 3phase 4wire TTB's & Commissioning at various stations in KPTCL & ESCOMs, under Turnkey & Buy Back basis of Released Energy Meters & Existing 3ph 3w TTBs.
- 2) Providing appropriate Test Terminal Blocks for the meter.
- 3) Modification of the existing wiring system if required, i.e., materials such as replacement of existing 3 phase 3wire TTBs by new 3phase 4wire TTBs if any, suitable wires and lugs for the commissioning of the Meters.
- 4) Modification of meter housing block in the existing panel if required.

The Scope also covers F.O.R.D at Store/Site in Indian Rupee basis, including packing, forwarding, handling, insurance, documentation, transportation, unloading charges etc. In case of imported equipment, the custom clearance and all necessary procedures have to be done by the bidder including any financial implications. The bids not covering the entire scope of proposal shall be treated as incomplete and liable for rejection.

1.2 The Tri-vector Electronic energy Meters for 11KV Feeder metering, ABT load survey shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer and purchaser shall have the power to reject any work or material, which in its judgment is not in full accordance therewith.

## 2.0 APPLICABLE STANDARDS

2.1 Unless otherwise specified elsewhere in this specification, the meter shall conform in all respects including performance and testing thereof to the following Indian/ International Standards to be read with up to-date and latest amendments /revisions

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thereof. In case, certain details are not covered in these specifications, any other Indian/ International standard shall be applicable.

| Sl. No | Standard No  | Title   |
|--------|--|---|
| 1      | IS 14697 :1999 (RA 2004) with latest amendments              | AC static transformer operated watt hour and VAR-hour meters, class 0.2S for both active and reactive energy.                   |
| 2      | IS 15959 : 2011(With latest amendments)                      | Data Exchange for Electricity Meter reading, Tariff and Load control – Indian Companion Specification (ICS).                    |
| 3      | CBIP, Technical Report No. 304 and CBIP Guide No. 325 : 2015 | Specification for AC static electrical Energy Meters and Testing.   |
| 4      | IEC-62053-22   | Electricity metering equipment (a.c) – Particular requirements – Part 22: Static meters for active energy (classes 0.2S & 0.5S) |
| 5      | IEC 62052-11   | Electricity metering equipment (AC) – General requirements, tests & test conditions Part 11: Metering equipment.                |

In case of any conflict or discrepancy, the order of precedence shall be

- (i) IS
- (ii) IEC
- (iii) CBIP Guide No.325.

In case of any difference between the provisions of these standards and the provisions of this specification, the provisions contained in this specification shall prevail.

## 2.2 BIS STANDARD MARK

Meters shall have BIS Standard 'ISI' Mark and supplier should possess valid BIS License.

## 3.0 CLIMATIC CONDITIONS

The meters shall be suitably designed and treated for normal life and satisfactory operation under the hot, cold and hazardous tropical climatic conditions. The meter shall be dust and vermin proof. All the parts and surfaces which are subjected to corrosion shall either be made of such material or shall be provided with such protective finish which provides suitable protection to them from any harmful effect of

  
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excessive humidity. The meter shall be required to operate satisfactorily and continuously under the following tropical climatic conditions:

|   |  |  |
|---|--|--|
| 1 | Temperature  | 4° C to 55°C                                       |
| 2 | Relative Humidity                                      | 45% to 95%<br>(Sometimes approaches saturation) to |
| 3 | Average annual rainfall                                | 3000 mm  |
| 4 | Max. wind pressure                                     | 150 Kg per Sq. meter                               |
| 5 | Max. Altitude  | 1000 meters.                                       |
| 6 | Average No. of dust-storm days per annum               | 40 days  |
| 7 | Average no. of rainy days per annum                    | 90 days  |
| 8 | No. of months of tropical monsoon conditions per annum | 3 months   |
| 9 | Isoceraunic Level                                      | 50 Days  |

#### 4.0 ELECTRICAL SPECIFICATION

##### 4.1 PRINCIPAL PARAMETERS

|                      |  |
|----------------------|--|
| Class Accuracy       | 0.2S for both active energy and reactive energy                          |
| Rated voltage (Vref) | 3 x 63.5 V AC Phase to Neutral (3 phase 4 wire system)                   |
| Voltage variation    | Meter should record correct energy for +20% of Vref to -30% of Vref      |
| Frequency            | 50 Hz $\pm$ 5%   |
| No. of phases        | Three phases   |
| Basic Current        | 1 Amp ( $I_b$ ) or 5 Amps ( $I_b$ ) (Will be specified by the purchaser) |
| Maximum Current.     | 200% of $I_b$  |
| Starting current     | The starting current of main measuring element shall be 0.1 % of $I_b$ . |

  
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|  |   |
|--|---|
| Power factor Range                     | Zero Lag-Unity-Zero Lead  |
| Power loss                             | <p>a) <b><u>Voltage circuit</u></b>: The active and apparent power consumption in each phase of voltage circuit including the power supply of meter at reference voltage, reference frequency and reference temperature shall not exceed 1.5 watt and 8 VA (Per Phase) respectively.</p> <p>b) <b><u>Current circuit</u></b>: The apparent power taken by the current circuit in each phase, at basic current, reference frequency and reference temperature shall not exceed 1 VA per phase.</p> |
| Short Time Over Current                | The short-time over current rating shall be 20 I <sub>max</sub> for 0.5 second at rated frequency.  |
| Surge withstand test                   | The meter shall withstand impulse voltage test at the rated impulse voltage of 6 kV as per procedure laid down in IS 14697:1999 (RA 2004)   |
| AC High voltage for class 2 Insulation | 4kV RMS for one minute  |
| Insulation Resistance Test             | The test shall be carried out as per procedure laid down in the IS 14697:1999 (RA 2004) Cl. 12.7.6.4 and the results shall conform to the IR value as mentioned in the above clause   |

#### 4.2 SUPPLY SYSTEM & POWER SUPPLY VARIATION

The extreme power supply variation for which an operating meter should withstand without damage and without degradation of its metrological characteristics when it is subsequently operated under its normal operating conditions shall be as follows:

Specified operating range: 0.80 to 1.1 V<sub>ref</sub>

Limit range of operation: 0.60 to 1.2 V<sub>ref</sub>

  
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The limits of error for voltage variation of + 20% to - 30 % of V ref shall be as under:

| Influence quantities |  | Value of current | Power Factor | Limits of variation in percentage error |
|----------------------|--|------------------|--------------|---|
|                      |  |                  |              | 0.2S                                    |
| i                    | Voltage variation                                  | $I_b$            | 1            | 0.1                                     |
|                      | between – 30% to +20%                              | $I_b$            | 0.5 lag      | 0.2                                     |
| ii                   | 10% of 3 <sup>rd</sup> harmonic in current circuit | $0.6 I_b$        | UPF          | 0.1                                     |
|                      |  | $0.6 I_{max}$    | UPF          | 0.1                                     |

#### 4.3 RUNNING WITH NO LOAD


When 70% and 120% of rated voltage is applied with no current flowing in current circuit, the test output of the meter shall not produce more than one pulse / count. The minimum test period for this test shall be as per IS 14697:1999(RA 2004).

4.4 The meters shall be suitable for directly connecting to voltage transformers (VTs) having rated secondary phase to neutral voltage of 63.5V and to current transformers (CTs) having a rated secondary current of 1 Amp or 5 Amps. Any further transformers/transducers required for their functioning shall be in-built in the meters. Necessary isolation and / or suppression shall also be built in, for protecting the meters from surges and voltage spikes, that occur in the VT and CT circuits of extra high voltage switchyards.

4.5 The meter shall continuously compute the average of the RMS values of the three line-to-line VT secondary voltages to obtain steady state values and display the same.

#### 4.6 AUXILIARY POWER

The meter shall draw auxiliary power for working of electronic circuit from any of the phases (L-L) or phase to neutral voltage of the VT secondary.

  
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#### 4.7 TEMPERATURE RISE

- a) Under normal conditions of use, external surface of the meter shall not reach a temperature, which might adversely affect the operation of the meters.
- b) With each current circuit of meter carrying rated maximum current and with each voltage circuit carrying 1.25 times the reference voltage (applied for 2 hours), the temperature rise on external surface of the case shall not exceed the following value at an ambient temperature of 45°C (2 hours duration test)

|   |      |
|---|------|
| Rise in temperature of external surface of the case | 15°C |
|---|------|

#### 4.8 LIMITS OF ERRORS

When meter is under reference conditions, the percentage errors for both active and reactive energy shall not exceed the limits as specified in IS: 14697:1999 (RA 2004) with latest amendments thereof.

#### 4.9 INFLUENCE OF QUANTITIES

The meter shall work satisfactorily under the presence of influencing quantities indicated under table No. 13 of IS 14697:1999 (RA 2004) with latest amendments.

#### 5.0 GENERAL AND CONSTRUCTIONAL REQUIREMENTS

The meter shall be compact in design. The entire design and construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.


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

- Personnel safety against electric shock.
- Personnel safety against effects of excessive temperature.
- Protection against spread of fire.
- Protection against penetration of solid objects, dust and water. (Meter shall conform to the degree of protection IP 51 of IS : 12063/IEC 62052-11 Clause 5.9)
- Provision of anti – tamper features.



## 5.1 METER CASE

- a) Meter case (base and cover) shall be made of **Unbreakable Flame retardant High grade UV stabilized Poly Carbonate** with minimum thickness of 2.0 mm and of good dielectric and mechanical strength.
- b) Meter case (base and cover) and extended terminal block cover should be injection moulded in UV stabilized poly-carbonate. **The Meter base shall be opaque. The meter cover and extended terminal block cover shall be kept fully transparent.** The moulded meter case should not change in colour, Shape, size, dimensions when subjected to 200 hrs on UV test as per ASTM D 53. It should withstand glow wire test as per IS 14697:1999 (RA 2004) and heat deflection test as per ISO 75. The Utility reserves the right to conduct tests for material verification at any time.
- c) The window portion shall be fully transparent, unbreakable UV stabilized polycarbonate for easy reading of all the displayed values/ parameters, nameplate details and calibrating LED. The window should be scratch and break resistant with silicon coating. It should not fade in course of time and become opaque causing inconvenience for reading.
- d) **The Meter cover should be ultrasonically welded or any other latest technology with meter base in such blocks of supplies where it is specifically requested.** The cover shall not just be held with base at two points of sealing. It should be firmly supported all along the boundary of base and cover of the meter as well, so that even before ultrasonic welding, the cover should fit perfectly with the base. The ultrasonic welding of meter case with base shall be such that if in case of any attempt to open the meter cover from base, there should be a clear visible evidence of opening / tampering of meter case, **meter shall display "Meter Cover Open" permanently.**
- e) The Meter case (Base and cover) shall have the following properties of plastic material. The utility reserves the right to test at appropriate laboratory preferably at CPRI. The vendors have to submit a separate sample meter if required.

  
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| Sl. No | Property  | Units     | Value          | Standards   |
|--------|---|-----------|----------------|---|
| 1.     | Physical water absorption                       | %         | Max. 0.35      | ASTMD 570/ IS:5133(part 2) :1969                                    |
| 2.     | Electrical Dielectric Strength at 90° C in oil. | kV/m<br>m | Min.16         | ASTMD 149   |
| 3.     | Thermal HDT                                     | ° C       | Min.125        | ASTMD 648-01 / ISO 75   |
| 4.     | Flammability                                    |           |                |   |
|        | a) Rating                                       |           |                |   |
|        | b) Glow wire test<br><br>650° C                 |           | FV<br>Passes 2 | UL94/ IS:11000 (part 2-sec-1)<br>IEC-60695-2-1-12 &<br>IS:11000-2-1 |
| 5.     | Mechanical                                      |           |                |   |
|        | a) Tensile strength                             | MPa       | Min. 50        | ISO 5271 any equivalent std.  |
|        | b) Flexural strength                            | MPa       | Min. 90        | ISO 1781 any equivalent std.  |
|        | c) Modulus of Elasticity                        | MPa       | Min.2000       | ISO 1781 any equivalent std.  |
|        | d) Izod impact                                  | kJ/Sq.    | Min. 8         | ISO 180/ I A or any equivalent                                      |
|        | Strength notched 23°C                           | m         |                | std.  |

  
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## 5.2 TERMINAL BLOCK, TERMINAL AND EXTENDED TERMINAL BLOCK COVER

- a) The terminal block shall be moulded type made of non-hygroscopic, flame -retardant material having good dielectric and mechanical strength. The moulded terminal block shall be made from best quality phenol formaldehyde/high impact strength UV stabilized Glass filled Poly Carbonate conforming to IS: 14697:1999 (RA 2004) having adequate insulating properties and mechanical strength with tin-plated brass inserts for connecting terminals.

The terminal block should satisfy all the conditions specified in IS: 14697 :1999 (RA 2004). The material of the terminal block should fulfill the requirement of following tests:

- The flame retardant rating of V 0 as per UL 94 testing.
  - The glow wire test for temperature of 960°C as per IS: 11000 (Part-2/Sec.I) or IEC 60695-2-1.
  - Heat deflection temperature (HDT) test of 135°C as per ISO 75 or ASTM D-648-01.
  - Ball pressure test at 125°C as per IEC 60335-1.
- b) The base of the meter should extend to enclose the three sides (back and two sides) of the terminal block.
- c) The meter terminal block shall have tin-plated brass terminal inserts. The terminals shall have suitable construction with barriers and cover to provide firm and safe connections of incoming and outgoing leads. The terminal screws shall have flat bottom so as not to pierce in the external conductors. All electrically live screws shall be of nickel/tin plated brass. The terminals shall be of suitable rating to carry continuously at least 250% of I<sub>max</sub> Current and made of electroplated (or tinned) brass. Any other provision which meets this in a better manner / way shall also be considered. The bidder should elaborate the provision adopted.
- d) The manner of fixing the external conductors to the terminal block shall ensure adequate and durable contact such that the contact resistance is minimum and there is no risk of loosening or undue heating. All parts of each terminal shall be such that the risk of corrosion is minimized. Two screws shall be provided in each incoming and outgoing terminal for effectively clamping the external leads or thimbles. Each screw shall engage at least 3 threads in the terminal. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. It should be possible to directly insert the solid or stranded wire into the terminals.

- e) The internal diameter of the terminal holes should be minimum 5.5mm (As per CBIP 4.2.2.3 Table 2) and adequately designed for inserting up to 16mm<sup>2</sup> Copper stranded armoured cable sizes and shall be capable of carrying continuous current up to 250% of I<sub>max</sub>. The holes in the insulating material of the terminal block, which form an extension of the terminal holes, shall be of sufficient size to accommodate the insulation of the conductors also. The clearance and creepage distances shall not be less than values specified in clause 6.6. of IS: 14697: 1999(RA 2004). Further, the supporting wedges between the two terminals of the terminal block should be of sufficient height to ensure that the two neighboring terminals do not get bridged by dust or a flash over does not take place.
- f) The termination of current circuit wires, if used, inside the meter (CT primary conductor) on the terminal block should be through lugs and washers of proper size. The loop length of the primary current circuit should be kept minimum. Alternatively, the CT primary conductor may be flattened to form a 'lug' like shape for proper terminating on terminal block without using lug or any other better arrangement may also be provided.
- g) The meter shall be supplied with a terminal cover which covers the meter terminals and generally the ends of the external wires or cables connected to the terminals and can be sealed independently of the meter cover. When the meter is mounted on the meter board and thereafter energized, no access to the terminals shall be possible without breaking the seals of the terminal cover.
- h) The sealing arrangement of the meter should be such that meter terminals shall be rendered inaccessible after the terminal cover is sealed. Provision for the seal should be made on front side of the meter terminal cover. The extended terminal block cover shall be designed such that the meter's internal parts are not accessible for tampering without breaking the seal(s). Suitable barriers in moulding shall be provided such that direct access to incoming/outgoing terminals is not possible through gaps left in cable entry holes after insertion of main/load side cables. The terminal cover shall be engraved/screen printed with logo of manufacturer.

- i) The terminals, terminal block and protective earth terminals should be in accordance with Clause 6.4 and Sub-Clauses thereof as per IS-14697:1999. The terminals may be grouped in a terminal block having adequate insulating properties and mechanical strength. The terminal block should be made from best quality non-hygroscopic, flame retardant material (capable of passing the flammability tests given in IS-11731) with nickel-plated brass or aluminium alloy or H-type lugs connectors for connecting terminals.
- j) The terminals in the terminal block shall be of adequate length in order to have proper grip of conductor with the help of two screws. The screws shall have thread size not less than M4 and head having 4-6 mm dia. The screws shall not have pointed ends (Flat ends) at the end of threads. All terminals and connecting screws and washers should be of tinned / nickel plated brass material or aluminium alloy.

The minimum clear distance between adjacent terminals in the terminal block shall be not less than 10mm. Preferably the CT and PT terminals should be separate.

- k) The terminal cover shall be of Engineering plastic with minimum thickness 2.5 mm and the terminal cover shall be of extended type completely covering the terminal block. The terminal cover shall be so provided that it remains permanently connected with meter base. The supplier shall suitably design the cover so that it opens or closes like a hinged door and the ends of hinged pins shall be flattened so that it does not come out. The access for the terminals shall be from the front/rear side of the meter.

### 5.3 DISPLAY PARAMETERS AND TYPE OF DISPLAY

- a) The meter should have bright LCD electronic display with backlit having minimum description of parameters (e.g. words like KWh, KVArh(Lag), KVArh (lead), KVA, KW, Power factor, Billing Parameters Values etc)/character height 8 mm and width of 5mm or higher and with minimum 8 digits(with two digits after the decimal ). The decimal digit shall be clearly distinguished from integer digits.

The LCD shall be of STN (Super Twisted Nematic) type, construction suitable for temperature withstand of 80°C (storage) and 65° C (operation). The LCD Display should have a wide viewing angle of 45° to 60° cone, up to one meter distance.

  
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The registered parameter shall not be affected or lost by power failure. The display shall not be affected by electrical & Mechanical disturbances. The Non-Volatile Memory (NVM) shall have a minimum retention time of 10 years under un-powered condition i.e. the NVM shall have a storage life (without use) of 10 years. The NVM shall be independent of battery backup.

All important data such as calibration data, billing parameters and cumulative KWh, KVARh, KVAh etc should be stored in NVM, internal to the main processing circuit and it should not be possible to change the data through any standard serial communication. For clear visibility of the display of the meter reading at a distance, large viewing area with large display icons is preferred. Display shall be with electronic back-lit display arrangement for better visibility.

The display of various parameters shall be scrolling one after another on auto and manual scroll mode. The meter shall be capable to measure & display continuously the active energy KWh, reactive energy KVARh and apparent energy KVAh at all loads & power factors i.e. Zero lag - Unity – Zero lead. The meter should also have provision for automatic recording of cumulative KWh at 24.00 Hrs on each day and the last day of the month for each calendar month and the same should be stored in billing register of memory. There shall be display of the daily 24.00 hrs reading for the last three days.

**b) Display Parameters:** The meter shall display the required parameters in two different modes as follows:


**AUTO SCROLL DISPLAY**

The display of following parameters herein after referred to as "Auto-Scroll parameters", shall be displayed in an auto-cyclic mode, in the following sequence:

1. LCD Segment Check
2. Meter Sl. No
3. Date & Time (Date: DD-MM-YY, Time: Hrs-Min.)
4. Phase Sequence and phase association
5. Cumulative Tamper Counts

**Instantaneous Values**

6. R Phase Voltage
7. Y Phase Voltage
8. B Phase Voltage
9. R Phase Current
10. Y Phase Current
11. B Phase Current

  
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12. Active Power
13. Reactive Power
14. Apparent Power
15. Phase wise PF (R,Y,B)
16. Three Phase PF with sign for lag / lead
17. Frequency

**Billing Parameters**

18. Forward KWh as on present Reset
19. Forward KWh as on previous Reset
20. Forward KVAh, lag
21. Forward KVAh, lead
22. Forward KVAh
23. Power Factor (Forward)
24. Reverse KWh as on present reset
25. Reverse KWh as on previous reset
26. Reverse KVAh, lag
27. Reverse KVAh, lead
28. Reverse KVAh
29. Power Factor (Reverse)
30. Forward KVA
31. Reverse KVA
32. Reset Count
33. MD Reset Date
34. Power On Time

**TOD Billing Forward**

Time Zone 1


35. KWh as on present Reset
36. KWh as on previous Reset
37. KVA
38. PF

Time Zone 2

39. KWh as on present Reset
40. KWh as on previous Reset
41. KVA
42. PF

Time Zone 3

43. KWh as on present Reset
44. KWh as on previous Reset

  
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45. KVA

46. PF

**TOD Billing –Reverse**

**Time Zone 1**

47. KWh as on present Reset

48. KWh as on previous Reset

49. KVA

50. PF

**Time Zone 2**

51. KWh as on present Reset

52. KWh as on previous Reset

53. KVA

54. PF

**Time Zone 3**

55. KWh as on present Reset

56. KWh as on previous Reset

57. KVA

58. PF

*\*Under Auto-scroll display, the display parameters from serial No: 35 to 58 (parameters for TOD billing forward and reverse) may not be required but provision shall be made to view them at the backend by using Laptop/Hand held downloading device.*

*\*Note: Exact number of prevailing Time Zones as per the KERC tariff order (TOD) & period will be intimated to successful bidder before commencement of supply.*

**Cumulative Parameters**

59. Cumulative Forward KWh

60. Cumulative Reverse KWh

The above parameters shall be rolled over every 9 seconds each. The display shall freeze and unfreeze on any selected parameter when initialized through one or more push buttons.


**PUSH BUTTON DISPLAY**

The following parameters shall be displayed, one after other, forward and backward with press of push button each time. The display shall have display time of 9 seconds for each measured value, except the LCD segment check. There shall be two push buttons, one for upward scrolling and another for downward scrolling of parameters.

**Group A**

1. LCD Segment Check

2. Meter Sl. No

  
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3. Date & Time (Date: DD-MM-YY, Time: Hrs-Min.)
4. Phase Sequence and phase association
5. Cumulative Tamper Counts

**Instantaneous Values**

6. R Phase Voltage
7. Y Phase Voltage
8. B Phase Voltage
9. R Phase Current
10. Y Phase Current
11. B Phase Current
12. Active Power
13. Reactive Power
14. Apparent Power
15. Phase wise PF (R,Y,B)
16. Three Phase PF with sign for lag / lead
17. Frequency


**Group B : Billing Parameters**

18. Forward KWh as on present Reset
19. Forward KWh as on previous Reset
20. Forward KVAh, lag
21. Forward KVAh, lead
22. Forward KVAh
23. Power Factor (Forward)
24. Reverse KWh as on present reset
25. Reverse KWh as on previous reset
26. Reverse KVAh, lag
27. Reverse KVAh, lead
28. Reverse KVAh
29. Power Factor (Reverse)
30. Forward KVA
31. Reverse KVA
32. Reset Count
33. MD Reset Date
34. Power On Time

**TOD Billing Forward**

Time Zone 1

35. KWh as on present Reset

  
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36. KWh as on previous Reset

37. KVA

38. PF

Time Zone 2

39. KWh as on present Reset

40. KWh as on previous Reset

41. KVA

42. PF

Time Zone 3

43. KWh as on present Reset

44. KWh as on previous Reset

45. KVA

46. PF

**TOD Billing –Reverse**

Time Zone 1

47. KWh as on present Reset

48. KWh as on previous Reset

49. KVA

50. PF

Time Zone 2

51. KWh as on present Reset

52. KWh as on previous Reset

53. KVA

54. PF

Time Zone 3

55. KWh as on present Reset

56. KWh as on previous Reset

57. KVA

58. PF

**Group C : Cumulative Parameters**

59. Forward KWh

60. Forward KVAh, lag

61. Forward KVAh, lead


62. Forward KVAh

63. Forward Cumulative MD in KVA

64. Reverse KWh

65. Reverse KVAh, lag

66. Reverse KVAh, lead

  
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- 67. Reverse KVAh
- 68. Reverse Cumulative MD in KVA

**TOD Cumulative Forward**

- 69. KWh Time Zone 1
- 70. KWh Time Zone 2
- 71. KWh Time Zone 3

**TOD Cumulative Reverse**

- 72. KWh Time Zone 1
- 73. KWh Time Zone 2
- 74. KWh Time Zone 3

**Group D : Average Values**

- 75. Average PF Forward
- 76. Average PF Reverse
- 77. Average KVA Forward
- 78. Average KVA Reverse
- 79. Average Raising Demand Forward
- 80. Average Raising Demand Reverse
- 81. Previous reset Forward Average PF (Independent of tariffs)
- 82. Previous reset Reverse Average PF (Independent of tariffs)
- 83. Raising Max demand (MD) in KVA import with tariff.
- 84. Raising Max demand (MD) in KVA export with tariff.

**Group E : ABT Parameters**

- 85. Cumulative Forward KVAh Lag High
- 86. Cumulative Forward KVAh Lead High
- 87. Cumulative Forward KVAh Lag Low
- 88. Cumulative Forward KVAh Lead Low
- 89. Cumulative Reverse KVAh Lag High
- 90. Cumulative Reverse KVAh Lead High
- 91. Cumulative Reverse KVAh Lag Low
- 92. Cumulative Reverse KVAh Lead Low
- 93. Frequency of current 15 min block
- 94. Net KVAh Lead High (Import KVAh lead – Import KVAh lag)with sign
- 95. Net KVAh Lag Low (Import KVAh lead – Import KVAh lag)with sign
- 96. Net KVAh Lead High (Export KVAh lead – Export KVAh lag)with sign
- 97. Net KVAh Lag Low (Export KVAh lead – Export KVAh lag)with sign

***\*Under PUSH-BUTTON display, the display parameters from serial no: 85 to 92 (ABT Parameters) may not be required but provision shall be made to view them***

*at the backend by using Laptop/Hand held downloading device.*

*\*Note: Exact number of prevailing Time Zones as per the KERC tariff order (TOD) & period will be intimated to successful bidder before commencement of supply.*

**Group F :Harmonics**

98. % THD of Voltage Harmonics for R Phase
99. % THD of Voltage Harmonics for Y Phase
100. % THD of Voltage Harmonics for B Phase
101. % THD of Current Harmonics for R Phase
102. % THD of Current Harmonics for Y Phase
103. % THD of Current Harmonics for B Phase
104. Maximum Average THD% in R Phase current for 30 minutes(Reset Period)
105. Date and time maximum average THD% in R phase current
106. Maximum Average THD% in Y Phase current for 30 minutes(Reset Period)
107. Date and time maximum average THD% in Y phase current
108. Maximum Average THD% in B Phase current for 30 minutes(Reset Period)
109. Date and time maximum average THD% in B phase current
110. Maximum Average THD% in R Phase current for 30 minutes(Billing Period)
111. Date and time maximum average THD% in R phase current
112. Maximum Average THD% in Y Phase current for 30 minutes (Billing Period)
113. Date and time maximum average THD% in Y phase current
114. Maximum Average THD% in B Phase current for 30 minutes (Billing Period)
115. Date and time maximum average THD% in B phase current.

*\*Under PUSH-BUTTON display, the display parameters from serial no: 104 to 115 (Harmonics) may not be required but provision shall be made to view them at the backend by using Laptop/Hand held downloading device.*

116. Quadrant of operation for RYB powers

**Group G : Energy History**

**Forward Cumulative KWh**

117. Cumulative KWh at latest reset- History 0
118. Cumulative KWh at latest reset- History 1
119. Cumulative KWh at latest reset- History 2
120. Cumulative KWh at latest reset- History 3
121. Cumulative KWh at latest reset- History 4
122. Cumulative KWh at latest reset- History 5

**Reverse Cumulative KWh**

123. Cumulative KWh at latest reset- History 0

- 124. Cumulative KWh at latest reset- History 1
- 125. Cumulative KWh at latest reset- History 2
- 126. Cumulative KWh at latest reset- History 3
- 127. Cumulative KWh at latest reset- History 4
- 128. Cumulative KWh at latest reset- History 5

**Billing Demand Forward**

- 129. Previous MD for History 0
- 130. Previous MD for History 1
- 131. Previous MD for History 2
- 132. Previous MD for History 3
- 133. Previous MD for History 4
- 134. Previous MD for History 5

**Billing Demand Reverse**

- 135. Previous MD for History 0
- 136. Previous MD for History 1
- 137. Previous MD for History 2
- 138. Previous MD for History 3
- 139. Previous MD for History 4
- 140. Previous MD for History 5

**Billing PF Forward**

- 141. Billing PF for History 0
- 142. Billing PF for History 1
- 143. Billing PF for History 2
- 144. Billing PF for History 3
- 145. Billing PF for History 4
- 146. Billing PF for History 5

**Billing PF Reverse**

- 147. Billing PF for History 0
- 148. Billing PF for History 1
- 149. Billing PF for History 2
- 150. Billing PF for History 3
- 151. Billing PF for History 4
- 152. Billing PF for History 5

***\*Under PUSH-BUTTON display, the display parameters from serial no: 120 to 122 (Forward Cumulative KWh ), serial no: 126 to 128 ( Reverse Cumulative KWh), serial no: 132 to 134 ( Billing Demand Forward), serial no: 138 to 140 (Billing Demand Reverse), serial no: 144 to 146 (Billing PF Forward), serial no: 150 to 152 (Billing PF Reverse) may not be required but provision shall be made***

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***to view them at the backend by using Laptop/Hand held downloading device.***

**Group H : Tamper**

- 153. Voltage Failure count Phase wise
- 154. Current Failure count Phase wise
- 155. Voltage unbalance count
- 156. Current unbalance count
- 157. Current Reversal count
- 158. Over Current Count
- 159. Last magnetic Tamper Occurrence with date and time
- 160. Magnetic Tamper Count
- 161. Cumulative tamper counts
- 162. Cumulative forward KWH for previous day D1
- 163. Cumulative forward KWH for second previous day D2
- 164. Cumulative forward KWH for third previous day D3
- 165. Meter software Version

A selected group from A to H shall be displayed by a command of the operator by using the push button provided in the meter. After reading a particular group so selected by the operator the group shall revert to Auto scroll parameters.

***Note: Bidder can also display the parameters in 3 separate display pages(Groups) and also at BCS end as per the sequence asked in the tender.***

**Note:**

- 1. Dot matrix type LCD shall not be accepted
  - 2. The LCD display of the meter should be backlit. The backlit should not glow during power off condition.
  - 3. The RTC accuracy should be within  $\pm 2$  minutes per year and crystal should be temperature compensated for temperature range of 0 to 50°C.
  - 4. The display with push button shall be auto off type. After the completion of display cycle, it should revert back to normal auto scroll reading after approximately 10 seconds. It shall not be necessary to keep button pressed and continue the display cycle. Fresh button press will be required after resumption of auto scroll cycle to display the above parameter again.
  - 5. Meter shall display direct reading and without multiplying factor.
  - 6. Depending upon the location of the meter, power flow from Main to Load is forward and power flow from Load to Main is Reverse.
  - 7. The Groups A to H referred above and High resolution parameters in (c) below are the "Display Parameters".
- c) High resolution display as indicated below shall be furnished. The display of high resolution shall be 8 digits with 2 digits for integer and 6 digits for decimals and shall be displayed as a separate group in the meter.

- Cumulative Forward Active Energy
- Cumulative Forward Reactive (Lead) Energy
- Cumulative Forward Reactive (Lag) Energy
- Cumulative Forward Apparent Energy
- Cumulative Reverse Active Energy
- Cumulative Reverse Reactive (Lead) Energy
- Cumulative Reverse Reactive (Lag) Energy
- Cumulative Reverse Apparent Energy.

d) The registers 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 shall not roll over in between this duration.

e) Parameter identifiers used in display: This shall be with universally accepted terms like KWh, KVA, KVArh and the abbreviations made for items like cumulative billing, TOD etc., shall be clearly printed and displayed on the main cover of the meter itself.

**f) Display Resolution for Forward and Reverse Registers**

1. Voltage = 0.01V
2. Current = 0.01A
3. Power Factor = 0.001
4. Active Energy = 0.01 KWh
5. Reactive Energy = 0.01 KVArh
6. Apparent Energy = 0.01KVAh
7. Demand=0.0001 KVA

**g) LCD Least Count:**

The internal least count of energy recording shall not be more than 0.001 kWh. Hence, every 0.001 kWh consumption will be internally stored. Also, there will be no loss of energy registration on account of frequent power outages due to high start up time of the meter.

To verify the above, the meter will be tested as per clause No. 9.2.2 IS 14697:1999 (RA 2004) with latest amendments.

**h) Self Diagnostic Features**

- i. LCD Segment Check' shall be provided to check all display segments.
- ii. The meter shall display unsatisfactory functioning or non-functioning of Real Time clock battery.

**i) Meter reading at Power outage**

The meter shall have industrial grade **Rechargeable or Replaceable** long life battery

with sufficient capacity to enable the meter reader to take meter reading even under power off conditions. All the displays of Push button mode should be made available in battery mode. The above battery activated through push button during power failure, shall be available throughout the design life (10 years) of the Meter. No power shall be consumed from the battery when mains are available.

In any case, Real Time Clock(RTC) Battery Power shall not be used for display under Power off condition. The other requirements of RTC and battery shall be as per clause 5.3k.

**j) Maximum Demand registration and MD resets**

The meter shall monitor the demand in KVA during the integration period set and record and display the maximum registered value. The rising demand under the present integration period shall be displayed along with the elapsed time. The integration period shall be either 15 minutes or 30 minutes and shall be selectable/field programmable for any other block period.

**Note :** As per CBIP Guide No.325,

HT Consumer meter – 15/30 minutes (default 30 minutes)

Grid Meters/Feeder meters – 15/30 minutes (default 15 minutes)

The meter shall have provision for maximum demand resetting through sealable push button and automatically at 24.00 hours of the last day of the calendar month irrespective of the meter is powered On or Off during the whole month . The meter shall display the maximum demand reset count. All MD reset shall be recorded as an event.

*Once the SAMAST is introduced in the country, the meter should be programmable to 5 min block period with in a period of 30days. The present supply of meters should be capable of migrate 5min block also. The bidder shall submit an **under taking** for migrating from 15min to 5min block at the time of uploading Tender documents.*

**k) Real Time Clock And Battery**

1. The MD integration cycle shall be on the basis of Real time clock of the meter. The maximum drift in real time clock of the meter shall not exceed  $\pm 2$  minutes per year and crystal should be temperature compensated for temperature range of 0 to 50°C when powered by internal battery or supply. A lithium battery of adequate storage energy shall be used for energy supply to real time clock during no voltage or power off condition. The minimum guaranteed life of battery should be ten years.

The meter shall have internal industrial grade Rechargeable or Replaceable battery with sufficient capacity to enable the meter reader to take meter reading even



under power off conditions. The industrial grade battery shall be capable to display the Push button parameters under the power off condition. In the case of power failure condition, the display shall be turned on through push button. The Rechargeable or Replaceable battery activated through pushbutton during the power failure should be capable of at least 50000 such operations.

2. There shall be provision for online synchronization of RTC through optical and RS 485/RS 232 communication port.

#### 5.4 OUTPUT DEVICE

The meter shall have two test output devices in the form of calibration LEDs of red colour with minimum intensity 10 mCD (milli-Candela) and 5mm diameter LEDs shall be accessible from the front and shall be convenient for monitoring with suitable testing/calibration equipment while the meter is in operation at site. The location of calibration LEDs should be such that the calibration pulses can be sensed easily through the sensor. The clearance of calibration LEDs from any of the sides of window portion shall be approximately 20mm.

The relation between test output and the indication on display shall comply with the marking on the name plate (pulse per KWh for active energy and pulse per KVARh for reactive energy).


Since the sequence of the output pulses may not be homogeneous, the bidder shall state the minimum number of pulse counts to ensure measurement accuracy of at least  $1/10^{\text{th}}$  as specified in the standard for the class of meter at various test points.

The resolution of the test output pulse(s) should be sufficient to conduct satisfactorily accuracy test at the lowest load in less than 5 minutes and starting current test in less than 10 minutes.

The pulse rate shall be freezed & it shall not be possible by the manufacturer or user to alter the meter constants at factory or at site.

#### 5.5 CALIBRATION

The meters should be software calibrated at the factory. All important data such as calibration data, billing parameters and cumulative kWh should be stored in internal NVM to the main processing circuit and it should not be possible to change the

  
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contents in it through standard serial communication ports. There shall not be any mechanical form of calibration technique, such as mechanical preset/trim pot or potentiometer so that any adjustment in calibration is not possible after freezing the meter constant. The meter shall be tested, calibrated and sealed at manufacturer's works before dispatch. This is to ensure that meter cannot be tampered at site.

## 5.6 LOAD SURVEY REQUIREMENT

The meter shall be capable of storing fifteen minutes data for the following parameters for the last minimum 35 days and necessary facilities to transfer this data for easy communication to data collection device i.e., MRI/Hand Held Unit (HHU) or PC to get the details in both numerical & graphic forms (in separate colour). This data shall be capable of being downloaded from the meter through MRI to PC or diverted to laptop/PC and printout facilities on first in first out basis. The supply of required software for this purpose is included in the scope of supply. The software should be capable of supporting forward and reverse compatibility with operating systems in use. Communication shall be through both serial and USB Ports of PC/Laptop. The meters shall have the AMR interface facilities.

Parameters required for load survey:

- i) Real time clock Date & Time
- ii) KWH (Import & Export)
- iii) KVAh (Import & Export)
- iv) KVArh, lag (Import & Export)
- v) KVArh lead (Import & Export)
- vi) Maximum Demand (Import and Export)
- vii) Current and voltage ( avg. of 15-min period) phase wise
- viii) Average frequency for each successive 15 min. block.
- ix) KVARH during 0.97pu and 1.03pu voltage.

The above parameters shall be selectable from the list. For selected parameters, 35 days profile shall be maintained by meter with integration period of 15 minutes. The time for download of complete load survey data of 35 days shall be less than two minutes.

## 5.7 COMMUNICATION CAPABILITY

The meter shall be ICS (Indian Companion Specification) compliant as per IS 15959:2011 with latest amendments. The meter shall have provision of a galvanically

  
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isolated optical port in front of the meter to download the data locally through CMRI/Laptop/PC. This port shall also be used for remote data reading through modem. An additional RS485/RS 232 port, in the form of physical interface connector RJ-11/RJ-45 which shall be used for remote meter data acquisition remotely through VSAT/PSTN/Optical fiber / GSM / GPRS / CDMA / PLCC / LPR communication medium and the RJ11/RJ45 used for remote meter data acquisition are to be wired and terminated to suitable Terminal Block in C & R Panel where meter is fitted. It shall not be possible to re- programme or make any change in the meter through CMRI. Communication protocol should be DLMS ICS compliant.

**The software should have programmable facility to restrict the access to the information recorded at basic security level as per 7.3.1 of CBIP Guide 325.**

**a. BCS Software**

For speedy and efficient data downloading through CMRI or directly to base computer, licensed copies of base computer software shall have to be supplied free of cost. The software provided shall be user friendly and menu driven on Windows based operating system. The meter reading software should also be provided for CMRI free of cost. One copy of each software namely Base computer software and CMRI software on CD is to be provided. The compatibility of transferring data from meter to CMRI and CMRI to base computer system should be easily established. The software shall have plug and play features to detect the establishment of connection with meter automatically. The data transfer should be highly reliable, fraud protected and tamper proof. No editing shall be possible on CMRI and base computer by any means. The software shall have capability to convert the entire data into ASCII format.

At any instant of time during communication with CMRI the display should not get disturbed and a suitable indication shall be made available in the Meter display/CMRI that communication has been established with CMRI. The software shall have data export facility to spread sheet format like MS-Excel /Open office without distorting stored data. Free of cost training for the use of software shall also be provided by the supplier.

As and when, the vendor releases new or latest or advanced versions of Firmware / Software, up to the guarantee period, the same should be made available to purchaser immediately by default on the release data free of cost . The latest versions should support all existing hardware/meters in the field supplied in this tender.

  
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The Bidder shall arrange demonstration of the local and remote data transfer process at their own cost. Only such of the bidders successfully demonstrating data transfer shall be considered. The date of demonstration shall be intimated to the techno commercially responsive firms.

Optical port of the meter shall be provided with a suitable covered sealing arrangement having no physical access from outside without breaking the seal. RS 485/RS 232 port should be provided under the terminal cover so that it cannot be accessed without opening the terminal cover. RS485/RS232 shall have suitable sealing facility.

- b. The software (Meter firmware) should support polling feature with optional selection of parameters for a separate AMR application as and when implemented by the purchaser. The Software shall have time stamp provision whenever downloading of data from Meter.

#### 5.8 MEASUREMENT OF HARMONIC ENERGY/PHASE CURRENT

1. The meter shall be capable of measuring total energy (consisting of fundamental plus harmonic energy) up to the 29th harmonic.
2. The capacity of measuring harmonic power/energy in terms of sampling rate shall be furnished.
3. The accuracy of current measurement under the presence of harmonics of 30% THD shall commensurate with the accuracy class of the active energy of the meter.
4. Special provision should be in the meter to know harmonic content of energy by downloading the data.
5. Harmonic Measurement :  
Display of voltage and current THD phase wise in % and shall support upto 29<sup>th</sup> harmonic.
  - % THD of voltage Harmonics Phase wise (R,Y,B)
  - % THD of current Harmonics Phase wise (R,Y,B)
  - % THD above the threshold value with date and time
  - **Record** the value of THD in current harmonics when it exceeds 8% with both date and time.
  - **Record** the value of THD in voltage harmonics when it exceeds 5% with both date and time.

- Meter shall log % THD (voltage and current) events in separate compartment and provide maximum 100nos of events in it as roll over basis. In summary, all the events (till 100 nos) will be logged always whenever % THD goes above the threshold as set in meter.

## 5.9 TAMPER AND FRAUD PROTECTION

The meter should have tamper and fraud protection features as per IS 15959 with latest amendments. In addition, the following shall be complied with if not included in IS 15959.

### a) Missing Potential

The meter shall be capable of detecting and recording occurrences and restoration of missing potential (any of the phases) which can happen due to intentional or otherwise, disconnection of potential leads, along with the total no. of such occurrences for all phases.

### b) CT polarity Reversal

The meter should detect CT polarity reversal and record the same with date and time of first such occurrences and last restoration along with total no. and duration of such occurrences during the above period for all phases.

### c) Voltage Unbalance

Whenever a particular phase voltage is  $<30\%V_n$  (Nominal Voltage) w.r.t any of the other phase voltages, then the meter should record and display a voltage unbalance for that phase.

### d) Current Unbalance

Whenever a particular phase is less by  $30\%I_n$  w.r.t any of the other phase currents, then the meter shall record and display a current unbalance for that phase.

### e) CT Open

The meter shall detect CT open if the current is below a defined threshold value, (current becomes less than 2% of  $I_n$  in any one or two phases), provided the phase voltage is above specified threshold.

### f) External Magnetic Field:

The meters shall comply with the requirements of CBIP Guide No. 325 on application of external magnetic fields (A.C. and D.C.) as per the value(s) specified in the CBIP Guide.

Besides the above, the meter accuracy or accuracy of display under normal

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conditions shall not be affected by placement of a permanent magnet, of 0.5Tesla+/-5% anywhere on the surface of the meter without meter box and the meter shall continue to record normally or record at I<sub>max</sub>.

- g) The threshold values for different tamper features shall be as under:
- i) The starting current of main measuring element as per IS 14697 : 1999(RA 2004) shall be applicable for neutral element.
  - ii) The threshold value of load for recording of energy under tamper condition shall in no case be more than 2% I<sub>n</sub>.
- h) The meter shall work correctly irrespective of the phase sequence of supply. (Clause 6.7.1c as per CBIP guide 325.)
- i) The meter shall keep working even in the presence of any two wires i.e. even in the absence of neutral and any one phase or any two phases. (Clause 6.7.1d as per CBIP guide 325.)
- j) Wrong phase association indication on display - Display of " **Phase Mismatch** " will be shown in case of wrong phase association between voltage and currents, e.g Voltage sequence is RYB and current sequence is RBY. During this condition, Auto Scrolling shall be locked with the above indication. However internal recording should continue.
- k) RTC failure indication on display- Display of RTC faulty shall be provided in case of RTC battery failure and RTC non advancement.
- Note :** Icon shall be provided for indication of the above mentioned points (j) and (k) in display.
- l) The accuracy of the meter should not be affected with the application of abnormal voltage/frequency generating device such as spark discharge of approximately 35 kV voltage at 10 mm spark gap. The meter shall be tested by feeding the output of this device to meter in any of the following manner for 10 minutes:
1. On any of the phase or neutral terminals.
  2. On any connecting wires of the meter.
  3. On communication ports.

***The above 5.9(l) is not required for this tender.***

The accuracy of meter shall be checked before and after the application of above

device(s) with site conditions. Also, meter shall be tested for immunity to Conducted Disturbances in accordance to IEC 62052-11 and any other tests as per relevant standards can be carried out.

The bidder should furnish the details as to how their meter is able to detect /protect the above tampers and fraud with sketches and phasor diagrams wherever necessary. Additional features, If any, in their meter may also be clearly indicated.

**Software tamper:** Any communication with the meter for any change in meter software or any attempt to write in meter software (software tamper) should record in the meter memory with date & time stamping. However, any communication for reading the meter data should not be recorded in the meter memory.

#### **TAMPER EVENTS :**

Meter should have features to detect and login occurrence and restoration of tamper events with capture parameters (with time and date) as specified in IS 15959: 2011 with latest amendments.

Persistence time 5 minutes + tolerance of 25 seconds.

**Meter Cover Open:** Display to be locked. The meter shall detect /log with date and time of meter cover opening as 'tamper', even in absence of supply. This tamper shall also be displayed on the meter LCD as 'Meter cover open.' Under such conditions, meter should be recording continuously and allow data download.

Last three hundred (300) events (occurrence + restoration), in total, shall be stored in the meter memory on first in first out basis. There shall be three separate compartments for logging of different types of anomalies:

|                  |  |
|------------------|--|
| Compartment No.1 | 100 events of voltage related events   |
| Compartment No.2 | 100 events of Current related events   |
| Compartment No.3 | 100 events other than above two events |

Once, one or more compartments have become full, the last anomaly event pertaining to the same compartment shall be entered and the earliest (first one) anomaly event should disappear. Thus, in this manner each succeeding anomaly event

shall replace the earliest recorded event, compartment wise. Event of one compartment / category should overwrite the events of their own compartments / category only. In general, persistence time of 5minutes + tolerance of 25seconds, for occurrence and restoration respectively need to be supported in meter.

Anomaly count should increase as per occurrence (not restoration) of anomaly events.

In the event the meter is forcibly opened, even by 2 to 4mm variation of the meter cover, same should be recorded as tamper event with date & time stamping and the meter should continuously display that the cover has been tampered and continue to update the parameters internally. When the top and bottom covers are separated display shall be locked with indication METER COVER OPEN.

#### 5.10 SEALING ARRANGEMENT OF THE METER

The meters shall be factory calibrated and ultrasonically welded or any latest technology (If specified by the purchaser) and sealed with numbered seals suitably before despatch.

The meter cover shall be permanently ultrasonically welded or any latest technology (If specified by the purchaser) to the meter base. It shall not be possible to open the meter cover without permanently damaging the meter cover or base, easily visible from the front. In order to make the ultrasonically welded or any latest technology meter base with cover, fool proof from tampering, two numbers of push-fit and double anchor type colourless transparent (see through), tamper evident, moulded polycarbonate seals of 18x14x7 mm size shall be provided on the meter case-cover boundary. Good quality seals should have six digits non-repeated numbers with embossing on both sides - one side with the logo of the manufacturer and the on the other side the logo of the purchaser. Only patented Polycarbonate seals (seals from the manufacturer who has official right to manufacture the seal) shall be used. Two sealing screws shall be provided for proper sealing of the meter cover so that access to the internal part shall not be possible without breaking the seal.

Additionally, two sealing holes shall be provided on meter case suitable for inserting sealing wire of min. 2mm dia. Two nos. of sealing screws should also be provided to seal the terminal cover by the purchaser.

The above sealing wire inserting arrangement (made at the factory premises) shall be integral part of moulded case. The provision of sealing shall also be integral part of the meter and the seals (provided to the main case at the factory) shall not be supplied



loose with the meter.

A tracking and recording software for all new seals shall be provided by the manufacturer of the meter so as to track total movement of seals starting from manufacturing, procurement, storage, record keeping, installation, series of inspections, removal and disposal.

#### **5.11 FIXING ARRANGEMENT OF METER**

Every meter shall have three fixing holes - one at the top and two at the bottom. The top hole shall be provided with a special clip at the back of the meter/shall be Key-hole so that holding screw is not accessible after the fixing of the meters. The lower fixing holes shall be provided on terminal block under the sealed terminal cover/on the base under the sealed terminal cover and meter is fixed by two screws so that after sealing the terminal cover both fixing screws cannot be accessed. The fixing screws shall be supplied with each meter in a pouch.

#### **5.12 MARKING OF METER**

The meter terminal marking and mounting arrangement should be as per Indian installation practices. The marking on every meter shall be in accordance with IS: 14697:1999 (RA 2004).

Every meter shall have name plate beneath the meter cover window portion such that the name plate cannot be accessed without opening the meter cover. The marking on the name plate shall be indelible, distinct and readable from outside the meter, housed inside a transparent meter box. The name plate details or Serial Number affixed in form of sticker shall not be accepted. The name plate marking should not fade or otherwise be adversely affected by Ultra Violet (UV) exposure with lapse of time. The basic markings on the meter name plate shall be as follows:

- a) Manufacturer's name or trade mark and place of manufacture.
- b) Designation of type.
- c) Number of phases and wires for which the meter is suitable.
- d) Serial number of the meter.
- e) Month and year of manufacture.
- f) Reference voltage, frequency.
- g) Basic current and rated maximum current in Amps.
- h) Principal unit (s) of measurement.

- i) Pulse Rate (imp / kWh and imp/KVArh).
- j) Class index of meter.
- k) Purchaser's order Number & date.
- l) Guarantee period - 5 years.
- m) Bar Coding of serial number.
- n) Sign of insulation.
- o) 'Property of KPTCL/ESCOM'
- p) ISI mark with license number.
- q) Category of Meter as per Specification.
- r) Identification of ABT compliance.
- s) Identification of TOD compliance.
- t) Protocol details and Firmware version

#### 5.13 CONNECTION DIAGRAM AND TERMINAL MARKINGS

The connection diagram of the meter shall be permanently engraved on the inside portion of terminal cover. Connecting terminals of current and voltage shall be in the sequence of Phase (in) – Phase (out). Eg : 1S 1L, 2S 2L, 3S 3L, M0, L0. The terminal marking should be clearly embossed on terminal block which is visible distinctly from outside.

#### 5.14 COMPONENTS

All the material and electronic power components used in the manufacture of the meter shall be of highest quality and reputed make like given as under so as to ensure higher reliability, longer life and sustained accuracy.


| Sl. No | Component function/ Feature  | Requirement   | Make/ origin to be specified |
|--------|------------------------------|---|------------------------------|
| 1.     | Measurement/ computing chips | The measurement or computing chips used in the Meter should be with the Surface mount type along with the ASIC. |                              |

  
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|----|-----------------------|--|--|
| 2. | Memory chips          | The memory chips should not be affected by external parameters like sparking, high voltage spikes or electrostatic discharges.   |  |
| 3. | Display modules       | a) The display modules should be well protected from the external UV radiations.   |  |
|    |                       | b) The display visibility should be sufficient to read the Meter mounted at height of 0.5 meter as well as at the height of 2 meters (refer 5.4a for Viewing angle).   |  |
|    |                       | c) The construction of the modules should be such that the displayed quantity should not be disturbed with the life of display (PIN Type).   |  |
|    |                       | d) It should be STN type industrial grade with extended temperature range.   |  |
| 4. | Communication Modules | Communication modules should be compatible for the two ports [one for optical port for communication with meter reading instruments & the other for the galvanically isolated RS 485/RS 232 port(RJ 11/ RJ45 connector) to communicate with various modems for AMR]. The time for download of complete load survey data of 35 days shall be less than two minutes. |  |
| 5. | Optical port          | Optical port should be used to transfer the meter data to meter reading instrument. The mechanical construction of the port should be such as to facilitate the data transfer easily.  |  |

  
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|     |                        |  |  |
|-----|------------------------|--|--|
| 6.  | Power supply           | The power supply should be with the capabilities as per the relevant standards. The power supply unit of the meter should not be affected in case the maximum voltage of the system appears to the terminals due to faults or due to wrong connections. Power supply should be unaffected by the magnetic field. |  |
| 7.  | Electronic components  | The active & passive components should be of the surface mount type & are to be handled & soldered by the state of art assembly processes.   |  |
| 8.  | Mechanical parts       | The internal electrical components should be of electrolytic copper & should be protected from corrosion, rust etc. The other mechanical components should be protected from rust, corrosion etc. by suitable plating / painting methods.  |  |
| 9.  | Battery                | Maintenance free Lithium with guaranteed life of 10 years  |  |
| 10. | RTC & Micro controller | The accuracy of RTC shall be as per relevant IEC / IS standards.   |  |
| 11. | P.C.B.                 | Glass Epoxy, fire resistance grade FR4, with minimum thickness 1.6 mm with moisture resistant coating.   |  |

  
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## 5.15 LED/LCD INDICATIONS


- a) LED/LCD shall be provided for following indications:
- 1) LED for Test output pulse (Imp/KWh) - Red
  - 2) LED for Test output pulse (Imp/KVArh) – Red
  - 3) Icon on LCD for current reversal
  - 4) Icon on LCD for magnetic tamper
  - 5) Icon on LCD for Low battery.
  - 6) Icon on LCD for phases available
  - 7) Icon on LCD for current failure in one or two phases.
  - 8) Icon on LCD for Meter Cover Open.
  - 9) Icon on LCD for wrong Association.
  - 10) Icon on LCD for RTC battery failure and RTC non advancement.

**Note:** During the occurrence of any of the above mentioned events from (7) to (10), Auto display parameters should be locked and meter should display the relevant icon permanently. But it should be possible to scroll through Push button mode. However after the restoration of the event, auto scroll should be restored.

- b) The location of calibration LEDs should be such that the calibration pulses can be sensed easily through the sensor. The clearance of calibration LEDs from any of the sides of window portion shall be approximately 20mm.

## 6.0 ADDITIONAL FEATURES

- a) Even if phase to phase voltage i.e. 110 Volts is applied continuously between phase and neutral of the meter, the meter should not get damaged and continue to record correctly within its class of accuracy after restoration of normal supply.
- b) The meters shall safely withstand the usual fluctuation arising during faults etc. In particular, VT secondary voltage of 120% of rated voltage applied continuously and 190% of rated voltage for 3.0 seconds, and CTs secondary currents 250% of rated current applied continuously and 20 times of maximum current applied for 0.5 second shall not cause any damage to or mal-operation of the meter [ as per IS 14697:1999 (RA 2004)].
- c) The meter shall be software calibrated. All important data such as calibration data, billing parameters, cumulative KWh, KVArh (lag and lead) and KVAh should be stored in internal NVM to the main processing circuit and it should not be possible to change it through standard serial communication. This will be verified by removing the NVM of the meter and check the working of the meter during sample testing or inspection.

  
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- d) The meter shall withstand impulse voltage test at the rated impulse voltage of **6kV** as per procedure laid down in IS 14697:1999 (RA 2004).
- e) Meter shall be fully functional within 5 Secs after the rated voltage is applied to meter terminals as per clause 11.4.1 of IS 14697:1999 (RA 2004).
- f) The meter shall conform to the degree of protection IP 51 of IS: 12063/IEC 62052-11 clause 5.9 for protection against ingress of dust, moisture and vermin.
- g) There should not be any change in the meter reading even at 120% & 70% of supply voltage.
- h) The meter should be free from jumps in the reading during sudden switching of heavy loads/ transient voltage spikes.
- i) Meter shall display direct reading and without multiplying factor. In case, requested by the purchaser, the CT/PT ratio of the meter shall be configurable.
- j) Principle of operation of the meter, outlining the methods and stages of computation of various parameters starting from input voltage and current signals including the sampling rate, if applicable shall be furnished by the bidder.
- k) The bidder shall furnish details of memory used in the meter.
- l) The meter shall compute the average frequency during each successive 15 minutes block and store in its memory.
- m) For reactive power and reactive energy measurement, limits of errors all the four quadrants shall be in accordance to IS14697:1999(RA2004).
- n) Historical billing data for 12 months should be provided in the meter.
- o) Each meter shall have LED for test output for active and reactive for checking the accuracy of measurement. These LEDs shall be visible from the front side.
- p) The functioning of the meter should not be influenced by the communication on either of the ports during data exchange or voltage fluctuations or on resumption of power supply.

## 7.0 TOD FEATURES

There shall be provision for at least eight TOD Zones for energy and demand. The number and timings of these TOD Zones shall be programmable as per the requirement of the utility. The present time zones are as follows.

TZ1 - 00:00 Hrs to 06:00 Hrs

TZ2 - 06:00 Hrs to 18:00 Hrs

TZ3 - 18:00 Hrs to 22:00 Hrs

TZ1 – 22.00 Hrs to 24.00 Hrs

***\*Note: Exact number of prevailing Time Zones as per the KERC tariff order (TOD) & period will be intimated to successful bidder before commencement of supply.***

## **8.0 ABT FEATURE**

The meter shall record the following in each block period :

1. Average frequency for previous block for 15 minutes integration period.
2. KVARh (Lead and Lag) when voltage <97%
3. KVARh (Lead and lag) when voltage >103%
4. Average voltage
5. Net Active Energy

## **9.0 ELECTROMAGNETIC COMPATIBILITY**

The meter shall meet EMI/EMC requirements as specified in the relevant standards described earlier in this specification and shall also be protected against radiated interference from either magnetic or radio frequency sources.

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

The disturbance(s)/discharge(s) to be considered are:

- (i) Fast transient burst test
- (ii) Electromagnetic H.F. fields
- (iii) Electrostatic discharges.
- (iv) Radio frequency interference suppression.

## **10.0 MANUFACTURING ACTIVITIES :**

- a) All the materials, electronics and power components, ICs used in the manufacture of the meter shall be of highest quality and reputed make like mentioned in this specification to ensure higher reliability, longer life and sustained accuracy and there shall be no drift in the accuracy of the meter throughout its guarantee period.
- b) The manufacturer should use application specific integrated circuit ASIC or Micro controller for metering functions.
- c) The electronic components shall be mounted on the printed circuit board using latest surface mounted technology (SMT) except power components by deploying automatic SMT pick and place machine and re-flow solder process. Further, the Bidder should

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own or have exclusive access (through hire, lease or sub-contract) of the aforementioned facilities.

Adequate documents regarding exclusive hire or exclusive lease shall be made available. In case of sub-contract, it shall be ensured that the sub-contractor is not carrying out sub-contracting for any other bidder in the above tender. The bidder shall indicate with the name and location of such facility along with an undertaking and certificate from the utility and any ambiguity, on such a confirmation shall result in immediate disqualification of the bidder.

The above shall be verified during works inspection or material inspection also and if any ambiguity is found, it shall be considered as a breach of contract by the successful bidder.

Bidders should have in-house design, development and manufacturing facility. The PCB material should be of glass epoxy FR - 4 grade conforming to relevant standards.

- d) All insulating materials used in the construction of meters shall be non-hygroscopic, non-aging and of tested quality. All parts which are likely to develop corrosion shall be effectively protected against corrosion by providing suitable protective coating.
- e) Quality should be ensured at the following stages:
  - At PCB manufacturing stage, each board shall be subjected to bare board testing.
  - At insertion stage, all components should undergo testing for conforming to design parameters and orientation.
  - Complete assembled and soldered PCB should undergo functional testing using test equipments (testing jigs).
  - Prior to final testing and calibration, all meters shall be subjected to accelerated ageing test to eliminate infant mortality.
- f) The calibration of meters shall be done in-house.
- g) The bidder should submit the list of all components used in the meter along with the offer.
- h) A detailed list of bought-out items which are used in the manufacture of the meter should be furnished indicating the name of firms from whom these items are procured. The bidder shall also give the details of quality assurance procedures followed by him in respect of the bought - out items.
- i) The details of testing facilities available for conducting the routine and acceptance tests and other special tests on the meter shall be furnished with the bid. The facility



available if any for conducting type test(s) may also be furnished.

## 11.0 SAMPLES FOR TESTING


- a) Two nos. of 1Amps and 5Amps each samples meters conforming to this specification duly sealed along with the routine test certificates shall be furnished with the bid.

*Note :- The main cover of one of the sample meters to be submitted along with the bid should be ultrasonically welded or any other latest technology (If specified by the purchaser). The main cover of the other sample meter need not be ultrasonically welded or any other latest technology , as at the time of sample testing, it shall be opened to ascertain conformity of meter's internal parts as per specification.*

- b) A team of Engineers from utility will be deputed to the factory premises of the bidder to assess the manufacturing quality and facility and also pick up **7 Nos** meters out of **25** meters LOT of 1 Amps as per requirement of tests either from storage places of factory or from the manufacturing line.
- c) The Bidder shall arrange demonstration of the local and remote data transfer process at their own cost. Only such of the Bidders successfully demonstrating shall be considered. The date and place of demonstration shall be intimated to the Techno commercially responsive firms.
- d) The above sample meters selected (**7Nos** meters) shall be tested in CPRI labs for all type and other tests covered under this specification or relevant standards as deemed necessary by the purchaser at the cost of bidder. The sample meters shall comply to the tests in all respects as per this specification.

In case sample meters are found not conforming to the requirements of specified tests conducted at CPRI, **the price bids of such firms will not be opened and offer will be rejected.**

- e) After six months of installation of meters of successful bidders, meters in the premises of purchaser will be released at the discretion of purchaser and taken out for testing in CPRI for conducting acceptance tests (As listed below) at the cost of KPTCL/ESCOM. The bidder's representative can also be present at the time of releasing. If the meters are found to be defective, B.G and EMD will be forfeited .The firm will not be eligible for participating for any tender for next 2 years.

  
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**List of Acceptance tests to be carried out on the released meters is as follows:**

1. AC High voltage test
2. Insulation test
3. Test on limits of error
4. Test of meter constant
5. Test of starting condition
6. Test of no-load condition
7. Test of repeatability of error
8. Test of power consumption test

## **12.0 TESTS**


### **12.1 TYPE TESTS**

- a) Type test as per IS: 14697:1999 (RA 2004) with latest amendments. The type test certificates for all tests as per IS: 14697-1999 (RA 2004) with latest amendments there off shall be furnished along with the offer. Type test certificates from any one of the standard Laboratories such as CPRI/ERDA/NPL/ERTL shall only be considered. The type test certificates shall not be more than 3 years old from the date of bid opening. In absence of these type test reports offer shall be rejected out rightly. Type tests should be conducted on meter having similar constructional and other features.
- b) Additional Test: In addition to the test mentioned at (a) above, bidder shall also have to furnish the following test reports. (Not older than 3 Years)
- i) **External AC/DC magnetic influence tests as per CBIP Guide No. 325 : 2015.**
  - ii) **Immunity to Conducted Disturbances in accordance to IEC 62052 -11.**
  - iii) **Compliance of anti-tamper features as per Clause 5.9 of this specification**

However, for the test mentioned from b) i) to iii) test certificates from standard Laboratories such as CPRI/ERDA/NPL/ERTL/NABL accredited lab shall be considered.

### **12.2 TESTS BEFORE COMMENCEMENT OF SUPPLIES :**

The successful bidders shall manufacture at least 15% quantity of annual requirement in this category and offer inspection call.

  
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a) **List of Tests:** Meter shall pass all the acceptance test as laid down in IS: 14697/1999 (with latest amendments). In addition, following tests shall also be carried out by adopting methods specified in IS: 14697 with latest amendments.

1. Vibration Test
2. Shock Test
3. Spring Hammer Test
4. Voltage Variation Test as per this specification
5. Permanent magnet test (as specified in Clause 5.9 of this specification)
6. External magnetic fields (A.C and D.C) as per CBIP Guide 325.
7. Glow wire test for polycarbonate material
8. Withstand Impulse voltage test at **6kV** shall be carried out on one sample from first lot as per procedure laid down in IS: 14697/1999 in NABL lab.
9. The sequence of display parameters shall be verified at the time of inspection in line with specification of the meter.
10. When the meter is placed in oven in energized condition with reference voltage at a constant temperature of 65° C for period of 120 minutes, the LCD should not deform physically and functionally. After keeping the meter in un-energized condition at a constant temperature of 80° C for period of 120 minutes and when restored at normal temperature, the LCD should work satisfactorily.
11. If phase to phase voltage i.e., 110volts is supplied between phase and neutral of the meter for 15 minutes, the meter should not get damaged and continue to record correctly after restoration of normal supply.
12. The accuracy of the meter may also be checked and it should not be affected with the application of abnormal voltage/frequency generating device such as spark discharge of approximately 35KV. The meter shall be tested by feeding the output of this device to meter in any of the following manner for 10 minutes:
  - On any of the phases or neutral terminals
  - On any connecting wires of the meter
  - Voltage discharge with 0-10mm spark gap
  - On communication ports

***Sl.no.12 is not required for this tender***

The accuracy of meter shall be checked before and after the application of above device(s) with site conditions.

13. The Meter shall be tested for Indian Companion Specification (ICS) compatibility

  
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(DLMS protocol) as per IS 15959:2011 with latest amendments and each communication port shall be tested for its working condition.

**b) Sampling Plan For Test for Acceptance as per Table 22 of IS 14697 :**

Number of samples for test from each lot shall be selected as per Annexure E, Clause No.12.2.2.1 of IS 14697.

| Sl. No. | Particular of tests   | Sampling plan for the lot of 1001 and above                  | Criteria for acceptance of lot           |
|---------|---|--|--|
| 1       | No load test and minimum starting current test  | 32 Nos.  | As per clause E-3.1 of IS 14697:1999     |
| 2       | All other acceptance tests including meter constant test as per IS & GTP except repeatability of error test, vibration test and shock test in sequence to be mutually agreed between Manufacturer and Inspecting officer. | 8 Nos. out of above 32 samples passing<br>Tests at sr. no. 1 | As per clause E-3.2 of IS Annexure E     |
| 3       | Repeatability of error test, vibration test and shock test, in sequence.  | 3 Nos. out of above 8 samples passing<br>Tests at sr. no. 2  | Each sample Should pass all Three tests. |

The sampling plan shall be as per IS: 14697 except that maximum lot size may be read as 1000 Nos. If offered quantity is more than 1000 Nos., sub-lots of maximum 1000 Nos. shall be taken for acceptance tests. Samples shall be selected at random from the each lot/sub lot of meters and acceptance test as per relevant standards and additional acceptance tests as per technical specification shall be carried out on these samples.

  
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**c) Facilities for conducting LOT Acceptance Test:**

Bidders should have all the facilities at their works to carry out lot acceptance test mentioned as per IS 14697. The standard meters used for conducting tests shall be calibrated periodically at Govt approved NABL Accredited Test laboratories and test certificates shall be available at Works for verification by purchaser's representative. **Bidders should have clearly mentioned the fact that they have all facilities to carry out Acceptance Test as per IS 14697 and, any false information in this regard shall be treated as breach of contract by the supplier and purchase order placed, if any, shall be liable for cancellation.** Vibration Test, Shock Test, glow wire test and impulse test 6kV mentioned in Cl.12.2 of IS 14697:1999(RA 2004) shall be conducted at any Govt. approved NABL Accredited Test laboratories at the time of acceptance of the LOT if the facilities are not available at Bidder's premises.

**12.3 ROUTINE TESTS**


All the Routine tests as laid down in IS: 14697:1999(RA 2004) with latest amendments along with Anti-Tamper Feature tests as described in Clause 5.9 of this specification shall be conducted on each and every meter by the manufacturer. Test results may be asked to be produced at any time by the purchaser or its representative. One set of routine test reports shall accompany each despatch consignment for reference.

**13.0 RANDOM SAMPLE TESTING AT RT/MT LAB AFTER RECEIPT OF METERS**

The sample of meters shall be selected randomly from the LOT of meters supplied at the stores approximately 100:25 ratio. This ratio can be changed by the purchaser. If any one meter fails in the testing, the entire lot of this supply shall be replaced by the supplier at free of cost. The samples will be selected by the purchaser's authorized officer. All the meters shall be sealed in RT/MT Lab before being despatched to the Store.

**14.0 GUARANTEED TECHNICAL PARTICULARS (GTP)**

The bidder shall furnish all the necessary information as desired in the schedule of Guaranteed Technical Particulars and data, appended. If the bidder desires to furnish any other information (s) in addition to the details as asked for, the same may be furnished against the last item of this schedule.

  
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## **15.0 PACKING AND TRANSPORTATION**

The meters shall be packed in cartons / crates suitable for vertical/horizontal transport as the case may be, and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully packed and marked with the appropriate caution symbol. Proper arrangement for lifting, such as lifting hooks or handles etc., shall be provided. Any material found short or broken inside the packing cases shall be supplied immediately by supplier without any extra cost.

The packing shall be done as per the manufacturer's standard practice. However, packing should be safe and water-proof and manufacturer should ensure the packing is such that, the material should not get damaged during transit by Rail/Road.

## **16.0 REPLACEMENT OF DEFECTIVE METERS**


If any one meter fails in the testing, the entire lot of this supply shall be replaced by the supplier at free of cost to the full satisfaction of the purchaser at the cost of supplier within 14 days of intimation by purchaser/stores officer.

## **17.0 MAINTENANCE & GUARANTEE:**

The meter shall be guaranteed for a period of **Six years** from the date of commissioning. The bidder shall replace the defective meters within a period of 14 days from the date of intimation from purchaser. The guarantee for the replaced meters shall start from the date of such replacement which shall be marked on name plate. In case defective meters are not replaced in stipulated period the penalty as per clause of delay in delivery shall be applicable.

## **18.0 QUALITY ASSURANCE PLAN (QAP)**

- a) The design life of the Meter shall be minimum 10 years and to prove the design life, the firm shall have at least the following quality Assurance Plan:
- The factory shall be completely dust proof.
  - The testing rooms shall be temperature and humidity controlled as per relevant standards.

  
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- The testing and calibrating equipments should be automatic and all test equipment shall have their valid calibration certificates.
- Power supplies used in testing equipment shall be distortion free with sinusoidal wave – forms and maintaining constant voltage current and frequency as per the relevant standards.
- During the manufacturing of the meters the following checks shall be carried out.
  - 1) Meter frame dimensions tolerance shall be minimum.
  - 2) The assembly of parts shall be done with the help of jigs and fixtures so that human errors are eliminated.
  - 3) The meters shall be batch tested on automatic, computerized test bench and the results shall be printed directly without any human interference.

**b)** The bidder shall invariably furnish the following information along with his bid:

- i) Statement giving list of important raw materials, names of sub suppliers for the raw materials, list of standards according to which the raw materials are tested. List of tests normally carried out on raw material in presence of bidder's representative and copies of test certificates.
- ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
- iii) Principle of operation of the meter, outlining the methods and stages of computation of various parameters starting from input voltage and current signals including the sampling rate, if applicable shall be furnished by the bidder.
- iv) The bidder shall furnish details of memory used in the meter.
- v) List of manufacturing facilities available.
- vi) Level of automation achieved and list of areas where manual processing exists.
- vii) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- viii) List of testing equipment available with the bidder for final testing of equipment specified and test-plant limitations, if any, vis-à-vis the type, special acceptance and routine tests specified in the relevant standards and this specification. The limitations shall be very clearly brought out in schedule of deviations provided with the tender.

  
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- c) The manufacturer who qualifies in the tests as per the clause 11 (e) will be continued for a period of one year. The supplier shall maintain record of the issue of meters as per annexure and this can be checked by Purchaser representative of the officer of the rank of Executive Engineer at all reasonable times. Any time after one year, the purchaser reserves the right to test the meters again and will be picked from the sub stations at random and the meters will be tested at CPRI lab at the cost of Purchaser.

## **19.0 ACCURACY OF METERS**

There will be no drift in the accuracy of the meters supplied against this purchase order for a guarantee period from the date of supply. In case any drift is noticed / found beyond permissible limits during this period, the supplier shall recalibrate such a meter for correct accuracy, and in the event, recalibration is not possible, replace such meter (s) by new meter(s) without any extra cost.

## **20.0 DOCUMENTATION**

1. The bidder shall furnish the following documents along with bid:
  - One set of drawing clearly indicating the general arrangements, fixing details, electrical connections etc.
  - Technical leaflets (user manual) giving operating instructions.
  - One copy of dimensional drawing of the box for each quoted category of the meter.
  - A list of all components used in the meter.
  - All information and documents as desired in clause-18 (QAP) above.
2. One operating manual shall be supplied to each consignee for every meter.
3. One set of routine test certificates shall accompany each dispatch consignment.

  
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