

Standard technical specification for 3-phase 4 wire CT/PT operated fully static AMR compatible tri-vector energy Meters for area ring fencing, substation feeders, distribution transformers & HT consumers prepared for R-APDRP projects

1.0 SCOPE

Design, manufacturing, testing, supply and delivery of AC, 3 Phase, 4 Wire, CT/PT operated fully Static and AMR compatible Tri-Vector Energy Meters for measurement of different electrical parameters listed elsewhere in the document including Active Energy (KWH), Reactive Energy (KVARH), Apparent Energy (KVAH) etc. The detail scope is given below.

2.0 APPLICATION

- a) As Boundary Meters for Ring fencing of an Area,
- b) In Substation on incoming/Outgoing HT feeders,
- c) On Distribution Transformers
- d) HT Consumers

3.0 STANDARDS TO WHICH METERS SHALL COMPLY

Guidelines on "Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification" enclosed with this document; as annexure.

IS: 14697 /1999 (reaffirmed 2004) Specification for AC Static Transformer operated Watt Hour & VAR-Hour meters (class 0.5S);

IS 15707 Specification for Testing, evaluation, installation & maintenance of AC Electricity Meters- Code of Practice

The equipment meeting with the requirements of other authoritative standards, which ensure equal or better quality than the standard mentioned above, also shall be considered; in case of conflict related with communication protocol, the Guidelines on "Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification" enclosed with this document as annexure shall prevail upon. For conflict related with other parts of the specification, the order of priority shall be – i) This technical specification ii) IS: 14697 /1999 (reaffirmed 2004).

4.0 GENERAL TECHNICAL REQUIREMENTS

1	TYPE	AMR Compatible Static, 3 Ph, 4 Wire Tri-Vector Energy Meter (Export/Import type for Boundary/ring fencing/interface meters)
2	FREQUENCY	50 Hz $\pm 5\%$
3	ACCURACY CLASS	0.5S
4	SECONDARY VOLTAGE	Suitable for operation from 110V Ph-Ph or 63.5V Ph-N
5	BASIC CURRENT (I _b)	~1 Amps or ~5 Amps, as per existing CT for feeders
6	MAXIMUM CONTINUOUS CURRENT	2.0 I _b ; Starting and Short time current shall be as per IS-14697
7	POWER CONSUMPTION	i) The active and apparent power consumption, in each voltage

		circuit, at reference voltage, reference temperature and reference frequency shall not exceed 1.5 W and 8 VA. ii) The apparent power taken by each current circuit, at basic current, reference frequency and reference temperature shall not exceed 1.0 VA
8	POWER FACTOR	0.0 Lag -Unity- 0.0 Lead
9	DESIGN	Meter shall be designed with application specific integrated circuit (ASIC) or micro controller; shall have no moving part; electronic components shall be assembled on printed circuit board using surface mounting technology; factory calibration using high accuracy (0.05 class) software based test bench.

5.0 CONSTRUCTIONAL REQUIREMENT/ METER COVER & SEALING ARRANGEMENT

The utilities may add their specific sealing requirements and meter COVER constructions required. Wherever poly carbonate cover is specified, it shall conform to IS 11731 (FH-1category) besides meeting the test requirement of heat deflection test as per ISO 75, glow wire test as per the IS:11000 (part 2/SEC-1) 1984 OR IEC PUB,60695-2-12, Ball pressure test as per IEC--60695-10-2 and Flammability Test As per UL 94 or As per IS 11731(Part-2) 1986

6.0 WORKING ENVIRONMENT

As per IS 14697 1998 (reaffirmed 2004). Meter to perform satisfactorily under Non-Air Conditioned environment (within stipulations of IS)

Meter body will conform to IP51 degree of protection. For outdoor use meter shall be installed in sealed enclosure conforming to IP 55.

The meter shall be suitable designed for satisfactory operation under the hot and hazardous tropical climate conditions and shall be dust and vermin proof. All the parts and surface, which are subject 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 injurious effect of excessive humidity.

7.0 MANUFACTURING PROCESS, ASSEMBLY AND TESTING

Meters shall be manufactured using latest and 'state of the art' technology and methods prevalent in electronics industry. The meter shall be made from high accuracy and reliable surface mount technology (SMT) components. All inward flow of major components and sub assembly parts (CT, PT, RTCs/Crystal, LCDs, LEDs, power circuit electronic components etc.) shall have batch and source identification. Multilayer 'PCB' assembly with 'PTH' (Plated through Hole) using surface mounted component shall have adequate track clearance for power circuits. SMT component shall be assembled using automatic 'pick-and-place' machines, Reflow Soldering oven, for stabilized setting of the components on 'PCB'. For soldered PCBs, cleaning and washing of cards, after wave soldering process is to be carried out as a standard practice. Assembly line of the manufacturing system shall have provision for testing of sub-assembled cards. Manual placing of components and soldering, to be

minimized to items, which cannot be handled by automatic machine. Handling of 'PCB' with ICs/C-MOS components, to be restricted to bare minimum and precautions to prevent 'ESD' failure to be provided. Complete assembled and soldered PCB should undergo functional testing using computerized Automatic Test Equipment.

Fully assembled and finished meter shall undergo 'burn-in' test process for 12 hrs at 55 degree Celsius (Max. temperature not to exceed 60 degree Celsius) under base current (Ib) load condition.

Test points should be provided to check the performance of each block/stage of the meter circuitry. RTC shall be synchronized with NPL time at the time of manufacture. Meters testing at intermediate and final stage shall be carried out with testing instruments, duly calibrated with reference standard, with traceability of source and date.

8.0 DISPLAYS

The meter shall have 7 digits (with \pm indication), parameter identifier, backlit Liquid Crystal Display (LCD) of minimum 10 mm height, wide viewing angle. Auto display cycling push button required with persistence time of 10 Seconds. LCD shall be suitable for temperature withstand of 70 deg C; Sequence of display of various instantaneous electrical parameters shall be as desired by Purchaser at the time of order.

The data stored in the meters shall not be lost in the event of power failure. The meter shall have Non Volatile Memory (NVM), which does not need any battery backup. The NVM shall have a minimum retention period of 10 years.

9.0 PERFORMANCE UNDER INFLUENCE QUANTITIES

The meters performance under influence quantities shall be governed by IS 14697-1999 (reaffirmed 2004). The accuracy of meter shall not exceed the permissible limits of accuracy as per standard IS: 14697 (latest version).

10.0 OUTPUT DEVICE

Energy Meter shall have test output, accessible from the front, and be capable of being monitored with suitable testing equipment while in operation at site. The operation indicator must be visible from the front and test output device shall be provided in the form of LED. Resolution of the test output device shall be sufficient to enable the starting current test in less than 10 minutes.

11.0 REAL TIME INTERNAL CLOCK (RTC)

RTC shall be pre-programmed for 30 Years Day/date without any necessity for correction. The maximum drift shall not exceed +/- 300 Seconds per year.

The clock day/date setting and synchronization shall only be possible through password/Key code command from one of the following:

- a) Hand Held Unit (HHU) or Meter testing work bench and this shall need password enabling for meter;

b] From remote server through suitable communication network or Sub-station data logger 'PC'.

12.0 QUANTITIES TO BE MEASURED & DISPLAYED

The meter shall be capable of measuring and displaying the following electrical quantities within specified accuracy limits for polyphase balanced or unbalanced loads :

- a) Instantaneous Parameters such as phase and line voltages, currents, power factors, overall kVA, kW, kVA_r, power factor, frequency etc as per details given in the table below and enclosed annexure.
- b) Block Load Profile Parameters such as kVAh/kWh/kVA_rh (lag/lead)/Maximum Demand (MD) in kW/kVA/power factor/phase and line voltages/currents etc (minimum 5 parameters) as per details given in the table below and enclosed annexure.
- c) Daily Load Profile Parameters such as cumulative energy kWh (Import/export)/cumulative kVAh (while kW- Import/export)/cumulative energy kVA_rh (quadrant-1/2/3/4)/reactive energy high (V>103%)/low (V<97%), etc as per details given in the table below and enclosed annexure.

In addition to above the meter shall also record the Name plate details, programmable parameters (readable as profile), occurrence and restoration of tamper events along with the parameters (Table A5.1, A5.2 and A6.1 to A6.8 respectively of enclosed guideline document)

Detail of category wise parameters requirement suitable for specific location such as feeder/DI metering, interface points/boundary points is given in following tables of guidelines document enclosed as annexure:

Category	Parameter group	Annexure Table No.
Substation Feeder/ Distribution Transformer meter	Instantaneous parameters	A2.1
	Block Load Profile parameters	A2.2
Boundary/Ring fencing/Interface Meters	Instantaneous parameters	A3.1
	Block Load Profile parameters	A3.2
	Daily Load Profile parameters	A3.3
HT Consumer Meters	Instantaneous parameters	A4.1
	Block Load Profile parameters	A4.2
	Billing Profile parameters	A4.3
Substation Feeder/ Distribution Transformer/Boundary/Ring fencing/Interface/HT Consumer Meters	Name Plate details	A5.1
	Programmable Parameters	A5.2
	Event Conditions	A6.1 to A6.7
Logging parameters for each of the event condition – shall be selected	Capture parameters for event as applicable (Event Log Profile)	A6.8

13.0 DEMAND INTEGRATION PERIOD

The maximum demand integration period may be set at 15 minute or 30 minute by purchaser as per requirement.

14.0 MD RESET

It should be possible to reset MD by the following options:

- a) Communication driven reset
- b) Local push button
- c) Auto reset at 24:00 hrs at the end of each billing cycle

15.0 MARKING OF METERS

The marking of meters shall be in accordance with IS: 14697 /1999 (reaffirmed 2004). The meters shall bear marking "Purchased under R-APDRP scheme".

The meter shall also store name plate details as given in the table A5.1 of annexure. These shall be readable as a profile as and when required.

16.0 COMMUNICATION CAPABILITY

The meter shall be provided with two ports for communication of the measured/collected data as per guideline document enclosed in the annexure, i.e. a hardware port compatible with RS 232 or RS 485 specifications which shall be used for remote access through suitable Modem (GPRS/GSM/EDGE/CDMA/PSTN/LPR) and an Optical port complying with hardware specifications detailed in IEC 62056-21. This shall be used for local data downloading through a DLMS compliant HHU.

The RS 485 port shall be used at Substations suitable for multi-drop connections of the meter for exporting data to sub-station data logger/DCU/Computer and the remote end server. The RS 232 port shall be used at boundary points meters and Distribution Transformer meters capable to transfer and export data to the remote end server through suitable communication mediums (GPRS/GSM/EDGE/CDMA/ PSTN/LPR). Both ports shall support the default and minimum baud rate of 9600 bps.

17.0 HAND HELD UNIT (HHU)

To enable local reading of meters data a DLMS compliant HHU shall be used. The HHU shall be as per specification given in the enclosed guidelines document. It shall be compatible to the DLMS compliant energy meters that are to be procured/supplied on the basis of this specification. The HHU shall be supplied by the meter manufacturer along with the meter. Numbers of HHU to be procured shall be decided by the purchaser.

18.0 TAMPER & FRAUD MONITORING FEATURES

The meter shall work satisfactorily under presence of various influencing conditions like External Magnetic Field, Electromagnetic Field, Radio Frequency Interference, harmonic Distortion, Voltage/Frequency fluctuations, and electromagnetic High Frequency Fields etc. The meter shall be immune to abnormal voltage/frequency generating devices and shall record the occurrence and

restoration of such tamper events along with parameters such as current, voltages, kWh, power factor, event code, date & time etc. (listed in Table A6.1 to A6.7 in enclosed document).

Tamper details shall be stored in internal memory for retrieval by authorized personnel through either of the following:

- i) HHU.
- ii) Remote access through suitable communication network.

Minimum 200 numbers of events (occurrences & restoration with date & time) should be available in the meter memory.

19.0 TYPE TESTS

The meter offered should have successfully passed all type tests described in the IS 14697 and the meter Data Transfer and Communication capability as per enclosed guidelines document. Type test certificate shall be submitted along with the offer and the same shall not be more than 36 months old at the time of bid submission. Make & type of major components used in the type-tested meter shall be indicated in the QAP. *The condition are to be relaxed by the purchasers (utilities) for the bids to be issued in next six months (i.e. upto Feb 2010) to accommodate design, development and testing of the new standard meters, conforming to the guidelines document enclosed as annexure, by manufacturers. The bidder shall have to submit the required type test certificate (as per bid requirement) to the purchaser (utility) at the time of meters delivery.*

Further Purchaser shall reserve the right to pick up energy meters at random from the lots offered and get the meter tested at third party lab i.e. CPRI / agencies listed at Appendix-C of Latest – standardization of AC static electrical energy meters – CBIP publication NQ.-304/ NPL / CDAL/ ERTL / ERDA at the sole discretion of the Purchaser. The supplier has no right to contest the test results of the third party lab or for additional test and has to replace/take corrective action at the cost of the supplier.

It shall be the responsibility of the supplier to arrange such tests and Purchaser shall be informed of the date and time of conduction of tests well in advance to enable him to witness such tests. Test charges of the testing authority, for such successful repeat type tests, shall be reimbursed at actual by the Purchaser.

20.0 ACCEPTANCE & ROUTINE TESTS

Criteria for selection for such tests and performance requirements shall be as per IS 14697-1999 (reaffirmed 2004)

Additional acceptance shall include Surge withstand (SWC) for 6 kV, as per IEC 62052-11, Lightning impulse test and HF disturbance test as per IS 14697. One sample meter per order from one of the offered lot shall be subjected to these specific tests. Meters subjected to these tests shall not be used after tests.

Accuracy tests shall be performed at the beginning and at the end of the acceptance tests specified.

21.0 QUALITY ASSURANCE:

The manufacturer shall have a comprehensive quality assurance program at all stages of manufacture for ensuring products giving reliable, trouble free performance. Details of the bidder's quality assurance and test set up shall be furnished with the bid. A detailed quality assurance program shall be finalized with the successful bidder during the award stage. Bidder shall furnish following information along with his bid:

- i) Organization structure of the manufacturer and his main sub-suppliers (PCBs, SMT cards, CT/PT) with details of 'QA' setup, overall workflow;
- ii) Copy of system manual showing 'QAP' (Quality Assurance Plan) as actually practiced during manufacturing and final testing.
- iii) List of raw materials and critical components (ASIC chip, crystal clock, memory register Chip, transformers, optical ports etc.) with their suppliers;
- iv) Stage inspection of product before final testing;
- v) Procedure adopted for 'In-situ' testing of PCBs, after placement of surface mounted component, for quantitative parametric variation of tolerance by self or sub-contractor.
- vi) Testing and calibration facility, date of calibration of test bench, manpower data of bench operators;
- vii) Sample copies of test certificate of bought out components.

22.0 QUALIFYING REQUIREMENTS

- i) Bidder should be a manufacturer;
- ii) He should have all the facility in his works for design, assembly, quality assurance, burn-in test (Fully assembled Energy Meter), testing (all routine and acceptance tests), automatic calibration of Energy Meter on software based test bench, qualified team of technical and software engineers;
- iii) The average annual turnover of the manufacturer for Energy meters for the three (3) best financial years out of last five (5) years, should be at least Rs.** Lakhs.
(** is $2 \times \text{Package Cost} \times 12 / \text{Work completion schedule in Months}$)
- iv) Notwithstanding anything stated herein under, the Purchaser reserves the right to assess the capacity and capability of the bidder to execute the work, should the circumstances warrant such assessment in the overall interest of the Purchaser.

23.0 GUARANTEE

Equipment (Meter) supplied shall be guaranteed for a period of 56 months from the date of supply or 60 months from the date of installation, whichever ends later. Bidders shall guarantee to repair or replace the meters and meter boxes (if supplied), which are found to be defective/ inoperative at the time of installation, or become inoperative/ defective during guarantee period. Replacements shall be effected within 1 month from the date of intimation.

The bidder shall extend the guarantee of 5 years. However the backup bank guarantee provided by the bidders shall be valid for 2 years only.

24.8 FIXING & CONNECTION ARRANGEMENT

Manufacturer shall ensure following technical points:

- i) Meter shall be suitable for mounting on Simplex type vertical panel with front door; CNT-M4 disconnecting type TBs to be used for Current circuit; Panel wiring to be properly dressed and harnessed; External cables to enter panel from bottom gland plate using double compression glands.
- ii) Meter installation & Inter-connection from existing CT/PT connections to energy meters in the panel shall be in the scope of contractor/bidder. The external cabling from existing CT/PT to Energy Meter panel shall be in the scope of purchaser.
- iii) Energy Meter terminals block shall be adequately sized with regard to maximum conductor dimension, commensurate with current rating of Energy Meter.

Application Guide for users of this specification

- 1. *The specification does not contain constructional details and methods of sealing of the meter COVER and the terminal sizes required for the Purchasers incoming cables. These may be added suitably as per the requirements of individual users. Quantities of meters required with / without meter COVER needs to be specified in the Bill of Quantities in the MIT specifications.*
- 2. *The MIT specification shall suitably incorporate the appropriate Qualifying Requirements considering the quantity of meters intended to be procured.*