Annexure 10

REQUIREMENT AND COMPONENTS OF PREPAID METERING SYSTEM

Single phase 2 wire (10-60) Amp pre-paid meter and Three phase 4 wire (20-80)Amp , 415 V P-P(240 V P-N) with in home display unit. Complete prepaid metering system with all related devices, software service and vending system. Meter should be complete in all respects with measuring element, main switch, display and keypad and comply with the requirements of the standards.

1. **SCOPE:**

This specification covers design, manufacture, testing and supply of single phase electronic, accuracy class 1.0 keypad Prepaid meters with split unit and provisions for TOD (Time of Day) tariff and R.T.C. (Real Time Clock).

The requirements of the online Vending/Transaction system to be provided for the keypad Prepaid metering system are also covered in the scope. The meter shall use keypad technology for the transfer of credit from the vending system to the meter. The meter shall contain the measuring element, main switch, display and keypad and comply with the requirements of the standards. The switch shall be used to disconnect customers depending on their load demand or the state of their account and shall be capable of operating over the life of the meter.

2. Separate display unit shall be provided with each meter. However recharging & parameter display facility should be available on both the units i.e. the display unit shall also have provision to enter the recharging encrypted code.(Separate display unit optional)

3. **SPECIFICATION FOR SINGLE PHASE& THREE PHASE PRE PAID KEY PAD TYPE ENERGY METER:**

3.1 STANDARD:

The meters with accuracy class–1.0 are required for measurement of Active Energy and shall conform to the latest edition of following standards:—

IS:13779	:	A.C. Static Watt Hour Meters (Class–1.0 and 2.0)
CBIP Report No. 88	:	Specification for AC static Electrical Energy meters
IS:15884	:	AC Direct Connected Static Prepaid Meters for Active Energy (Class 1 and Class 2)

3.2 BIS MARK:

The offered Prepaid meter should be approved as per the IS:13779.

3.3 CLIMATIC CONDITIONS:

The meter is required to operate satisfactorily and continuously with specified accuracy under hot, dusty and tropical conditions and other climatic condition specified as herein after:—

i)	Specified operating range		:	–10°C to + 55°C
ii)	Limit range of operation		:	–25°C to + 55°C
iii)	Limit range of storage and Transport		:	–25°C to + 70°C
iv)	RELATIVE HUMIDITY:			
	(a)	Annual Mean	:	<75 percent
	(b)	For 30 days (spread over one year)	:	<95 percent
	(c)	Occasionally on other days	:	<85 percent
v)	Maximum attitude above M.S.I.		:	1000 Meter
vi)	Average Annual rain fall		:	1200 mm.

3.4 CURRENT AND VOLTAGE RATING:

Rated Voltage (Vref) : 240 V Phase to Neutral

Rated Current (For Single Phase) : Basic Current 10A (Ib)
Maximum current 60A (Imax)

Rated Current (For Three Phase) : Basic Current 20A (Ib)
Maximum current 80A (Imax)

3.5 VARIATION IN POWER SUPPLY:

The meters shall be suitable for working satisfactorily with the following power supply system variations:—

3.5.1 VOLTAGE RANGE:

(i)	Specified Operating Range	:	0.7 to 1.3 Vref (-30% to +30%)
(ii)	Operating voltage range for accuracy requirement	:	0.85 to 1.15 Vref i.e. –15% to + 15%

3.5.2 FREQUENCY VARIATION:

The standard reference frequency for performance shall be 50Hz with tolerance ± 5%.

3.6 POWER CONSUMPTION:

3.6.1 VOLTAGE CIRCUIT:

The active, apparent Power consumption in voltage circuit including the power supply of the meter at reference voltage, reference temperature and reference frequency shall be within limits as specified in relevant IS.

3.6.1 CURRENT CIRCUIT:

The apparent Power taken by each current circuit at basic current, reference frequency and reference temperature shall be within limits as specified in relevant IS.

3.7 STARTING CURRENT:

The meter shall start registering the energy at 0.2% of Ib.

3.8 ACCURACY:

Class of accuracy of meter shall be 1.0 and shall conform to accuracy requirement as per specified IS.

3.9 KEYPAD PREPAID METER:

The keypad buttons shall have numbers/letters on them, which shall be clearly visible and resistant to wear. The layout of the numbering shall be same as that used on standard telephones for numbers '1' through '9' and buttons such as '*', '0', and '#'. Button '5' shall have some form of physical identification (raised printing or a pip) to aid customers with poor sight.

The keypad IP rating shall be adequate to permit use with moist or wet hands whilst ensuring the safety of the user and preventing ingress of dirt and water to the unit. The keypad buttons shall provide audible feedback when pressed with differing tones to distinguish between valid and invalid entry. The entry of codes for credit or commands associated with programming functions such as tariff change shall be via encrypted numeric codes. Code encryption / decryption must be carried out using an internationally recognized standard (e.g. Triple DES). The meter shall permit a time delay of up to 20 seconds between subsequent keystrokes.

The meter has Keypad buttons which enables the user to view various displays available on the meter. The display parameters shall be as follows:

- Days Left (based on consumption of last seven days)
- Value of recent consumption
- The currently active rates, the prices charged for consumption at each rate, and the number of units consumed at each rate and the daily charges.
- Last 5 recharge codes entered in to the meter
- "Authenticated Billing Code (ABC)"#
- The total amount vended
- Shows the Refund code
- Displays monthly consumption in Rupees / kWH
- Maximum Demand with occurrence of time and date
- Instantaneous load and the projected hourly cost of use at this load
- Date/Time, Serial no.
- Voltage, current etc.
- Key code mode for punching code in to the meter

"Authenticated Billing Code":

The meter shall display the 20 digit authenticated meter reading code. The full 20 digit token shall contain the following frozen value at midnight (00:00 Hr) of month end

1. 5 digit cumulative kWh energy register.
2. Date of frozen data.
3. Credit balance, it may be positive or negative.
4. The tamper flag, which only indicates whether there is any tamper or not.

3.10 TARIFF:

The meter should be programmable for the tariff order in vogue entirely and will be updated from time to time as per the tariff order, through vending code. The MIS report will be generated by the Agency and submitted to the BHEL indicating list of consumers whose tariff has not been changed to new tariff.

Following are the features required in the meter for Tariff. It shall be possible to change the tariff related parameters through vend code.

3.10.1 Minimum charges: Using the online vending system it shall be possible to define the minimum charge for the applicable tariff category. If the consumer consumes electricity equivalent of amount less than the minimum charge then at the end of the billing period the meter shall deduct the difference of the minimum amount and the monthly consumption (Amount).

3.10.2 Fixed Charges: Meter shall be able to deduct fixed charges on daily basis such as meter rent, sanctioned load based charges etc. The fixed charges shall be defined using the online vending system.

3.10.3 Tax/Duty: It shall be possible to define the tax percentage through online vending system which has to be levied on the amount of the energy consumed.

3.10.4 Debt Management: It shall be possible to collect the debt from the consumers with the use of the online vending system. The debt percentage shall be defined in the vending system.

3.11 COMMUNICATION CAPABILITY:

The meter shall be provided with an optical communication port. It shall be possible to read the meter through the optical port with held hand device.

3.12 GENERAL REQUIRMEENTS

Meter shall be designed and constructed in such a way as to avoid introducing any danger in use and under normal conditions so as to ensure specially the following:—

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

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

3.12.2 All insulating material used in the construction of meter shall be non-hygroscopic, non ageing and of tested quality and shall conform to tests as specified in relevant Standards.

3.12.3 The meter shall be designed on application specific integrated circuit and shall be manufactured using SMT (Surface Mount Technology) components.

3.12.4 The terminal block, the terminal cover and the meter case shall ensure reasonable safety against the spread of fire. They should not be ignited by thermic overload of live parts in contact with them.

3.12.5 The meter shall conform to the degree of protection IP 51 against ingress of dust, moisture and vermin.

3.12.6 All parts which are subject to corrosion under normal working conditions shall be protected effectively. Any protective coating shall not be liable to change by ordinary handling due to exposure to air under normal working conditions.

3.12.7 The meters shall be designed such that their working remains unaffected by electromagnetic interference, electrostatic discharges and high voltage transients as specified in standard.

3.13 CONSTRUCTIONAL REQUIREMENTS:

3.13.1 Meter Case:

a. The meter shall have completely insulated body and be of wall mounted projected type. The meter shall have a case made of unbreakable high grade fire resistant, reinforced polycarbonate or equivalent high grade engineering plastic which can be sealed in such a way that the internal parts of the meter are accessible only after breaking the meter cover seals. The meter cover shall have at least two sealing screws, each screw having the sealing holes.

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

c. The meter case shall be ultrasonically welded with the meter cover in such a way that it should not be possible to open the meter cover without damaging the cover.

3.13.2 LCD Unit:

The display unit shall be Pin type built-in liquid crystal display. The measured value(s) shall be displayed on minimum six digit Liquid Crystal display (LCD) i.e. display unit, having minimum character size of 8mm X 4mm. When the meter is not energized, the display need not be visible. Each display shall be retained for a minimum period of 2s.

3.13.3 Window:

The meter cover shall be of high grade, fire resistant, reinforced polycarbonate or equivalent high grade engineering plastic with one window made of UV stabilized, silicon coated polycarbonate or equivalent high grade engineering plastic for reading the register. The window shall be integral part of the meter cover such that it can not be removed undamaged without breaking the meter cover.

3.13.4 Terminals and Terminals block:

a. The terminal block shall be made from best quality non-hygroscopic, fire retardant, reinforced polycarbonate (not bakelite) or equivalent high grade engineering plastic which should form an extension of the meter case. If shall have terminal of minimum internal diameter 8.5mm

b. The meter shall be provided with terminal to connect the cables. The screws shall not have pointed edge at the end of thread. The clearance and creep age distance of terminal block and tips between the terminal and the surrounding parts of metal enclosure shall be as per relevant IS standard.

c. All parts of each terminal shall be such that the risk of corrosion resulting from contact with any other metal part is minimized.

d. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material.

3.13.5 Terminal Cover:

a. The meter terminal Block shall be provided with an extended terminal cover with independent sealing arrangement in such a way that it shall cover the terminals, the conductor fixing screws, the external conductors and their insulation i.e. no part of meter or cable accessories shall be visible from the front of the meter.

b. When the meter is mounted, no access to the terminals shall be possible without breaking the seal of the meter terminal cover.

3.13.6 Terminal Arrangement:

A diagram of connections should be provided inside the cover the terminal block. The terminal cover shall be extended such that when it is placed in position it is not possible to approach the connections or connecting wires.

3.13.7 Name Plate Marking:

The name plate shall have following markings which shall be indelible, distinct and readable from outside the meter:—

- Manufacturer's name and/or trade mark and the place (with country) of manufacture;
- Designation of type;
- The no. of phases and no. of wires for which the meter is suitable for;
- The manufacturer's serial number and year of manufacture;
- Reference voltage;
- The basic current and the maximum current;
- The principal unit in which the meter reads;
- Meter constant;
- Class index of the meter;
- Reference Frequency;

3.14 TAMPER AND FRAUD PROTECTION:

The meter shall operate normally under the following conditions:

3.14.1 Phase current reversal: The meter shall record forwarded energy.

3.14.2 Neutral current reversal: The meter shall record forwarded energy.

3.14.3 Phase and neutral interchange: The meter shall record forwarded energy.

3.14.4 The meter shall operate normally in case the phase and neutral are swapped with neutral connected to earth.

3.14.5 In case the neutral is opened with earth load connected, partial phase by pass or full phase bypass the energy shall be recorded on the wire which has higher current recording. Such tampers shall be logged in the memory of the meter.

3.14.6 The metering system shall be provided with adequate magnetic shielding so that any external magnetic field (AC Electro Magnet or DC Magnet) as per the values specified in standard applied on the metering system shall not affect the proper functioning and recording of energy as per error limits prescribed by standard.

3.14.7 Measurement shift: The meter shall have measuring element for both phase and neutral to avoid tampering with neutral. The energy measurement shall always be done on the element with higher current and it is preferable to supply the CT's for both phase and neutral. The meter shall detect the measurement shifting from phase to neutral circuit and neutral to phase circuit in the memory. This shall be done by finding the imbalance between phase and neutral current and comparing with the pre defined threshold and the persistence time.

3.14.8 If neutral is disconnected from both supply & load side the meter shall not power up and / or shall disconnect the supply.

3.15 TESTS

3.15.1 Type Tests

Meter shall be fully type tested as per IS 13779/1999 (amended up to date) and external AC/DC magnetic influence tests as per CBIP Tech-Report 88. The Type Test Reports shall clearly indicate the constructional features of the type tested meters. All the Type Tests shall have been carried out from any NABL accredited Laboratories to prove that the meters meet the requirements of the specification.

3.15.2 Meters shall pass the entire acceptance and routine tests as laid down in IS: 13779/1999 (amended up to date) and also additional acceptance tests as prescribed in this specification.

3.15.3 Prepaid functionality shall be tested by the BHEL as per IS: 15884 / 2010.

3.15.4 Other Acceptance tests

i) The meter shall withstand continuously for a period of at least 5 minutes at a voltage of 440 V between phase and neutral without damage/problems,

ii) Power consumption tests,

iii) The meter shall withstand impulse voltage at 10kV.

iv) The meters shall be tested at (-) 15% and at (-) 30% of reference voltage as well as (+) 10% and (+) 20% of reference voltage and shall record energy within limits of variation as per relevant IS.

v) For other influence quantities like frequency variation the limits of variation in percentage error will be as per IS: 13779/1999 (amended up to date).

vi) The meter shall detect the measurement shifting from phase to neutral circuit and neutral to phase circuit in the memory. This shall be done by finding the imbalance between phase and neutral current and comparing with the pre defined threshold and the persistence time. The condition for measurement shift shall be according to below conditions and the meter shall log the forwarded energy in this conditions:

1	Interchanging of phase & neutral terminals.
2	Neutral connected on incoming side but connected to earth via resistor on outgoing side. Load is connected solidly to ground.
3	Phase & neutral interchanged at incoming and load is connected to earth.
4	Shorting is provided on current coil terminals.

vii) Meter shall record accurate energy in case of external magnetic influencing signals as per the IS13779. Meter shall be immune up to 0.5T permanent magnet and the switch shall not operate in this condition. In case of abnormal magnetic field such as continuous DC magnetic induction of 0.27 Tesla ± 5% and magnetic induction of 10 milli Tesla the meter shall perform the following features:

a) Meter shall log the event in its memory as Magnetic tamper with date and time stamp.
b) Meter shall show "TAMPER" in the display.
c) Meter shall start recording at 100% of Imax (Defrauded metering)

3.15.5 Demonstration of Meter:

Two nos. Single Phase Prepaid meter with vending software and token generation system must be Demonstrated by bidder within 15 days of opening of Part-I. Below mention operation shall be done on demonstration meters and bidders' representative shall be well equipped to demonstrate desired features:-

a) Vending system operation.

b) Test of application of tariff.

c) Token generation.

d) Token punch & checking all display parameters on meter as well as parallel home display unit

e) Balance available in the meter.

f) Test of friendly credit hours start & end time

g) Test of disconnect the output supply once when credit reach to zero.

h) Test of reconnect the output supply on providing credit limit / charging with new token.

i) Test of disconnect the out supply if load / current exceed the preset value in the meter.

j) Test of reconnect the out supply if load / current falls below the preset value in the meter.

k) Test of visible / audible over load warning.

l) Test of visible / audible low credit warning.

m) Authentic Billing Code (ABC) verification.

n) All tampers shall be tested as mentioned in the specification.

4. CONSUMER INTERFACE UNIT (CIU):

- The meter shall be supplied with a separate In-home display unit /CIU.
- The display unit shall be powered up from the meter
- The display unit shall have a LCD display.
- The display unit shall have a key pad to enter the code. The keypad should be similar to the keypad available on the meter.
- The display unit shall have an connection port to connect to the meter.
- The display unit and energy meter shall be connected using a 4 wire connection cable (Similar to telephone cable).
- The display unit shall have a buzzer to generate alarm signal in case of low credit and overload.
- The In-home display unit /CIU should be provided with 5 meter 4 wire connection cable (Similar to telephone cable).

5. METER DATA READ THROUGH MRI AND / OR BCS:

It shall be possible to read the prepaid meters and minimum following information shall be available in meter reading data.

- The transaction history data with date and time.
- All the events history with time based and category based information.
- Tariff details including the TOD tables, slab tables and information about the current active rate price.
- Monthly history and consumption data of the energy consumed for last twelve months.
- All the account related information like meter credit, emergency credit details, minimum charge and fixed charges value.

- All the limiting parameters shall also be available in meter reading.

6. VENDING SYSTEM REQUIREMENTS:

This section specifies the requirements of the vending system for currency based Prepaid metering solution.

The meter shall work on the latest currency transfer keypad technology supported by an online vending system. Since the keypad technology is future proof, cost effective and in this communication age, enables consumers to buy electricity over the multiple vending options.

The vending system shall use Triple Data Encryption Standard (Triple DES), i.e. it provides three levels of encryption for the vend code. The code shall be meter specific and can't be used in any other meter. Triple DES is widely used in banking systems worldwide due to the high level of security provided by the algorithm.

The necessary licensed Software for each Vending Station at BHEL billing centre shall be provided by bidder.

The vending system shall be the online vending system from where the vend codes shall be issued.

7. VENDING PROCESS:

7.1.1 On receipt of the vend request the system shall have a provision to ascertain the identity of the consumer. The keys to identify the consumer shall be the meter serial number or consumer premise number.

7.1.2 The vend terminal shall send the request to a central database that shall authenticate the transaction and generate an encrypted code.

7.1.3 In order to provide maximum security to the system the encryption shall not be done on the vend terminal.

7.1.4 On receipt of each request the vend terminal shall connect to the central database and get the code generated.

7.1.5 The code hence generated shall be printed on paper using the attached printer.

7.1.6 The vending system shall be used to transfer current values (Rupees) to the meter.

7.1.7 The consumer shall pay the money at the vend terminal, this information when fed to the vend terminal shall be send to the central database that shall encrypt the token using Triple DES encryption algorithm.

8. DATA MONITORING CENTRE (DMC):

The DMC shall be a part of the vending system which shall have capability to interface with the central database and produce the management reports as detailed in the specification. It shall manage all administrative data, including settings of system accounts, tariffs, meter and Consumer data. It shall also provide reporting system for system analysis.

Various tasks that should be performed from the DMC are outlined below:

8.1.1 Consumer Database Management

- Entry of new consumers and their details
- Existing consumer database

8.1.2 Meter Database Management

- Uploading of meter database

8.1.3 Tariff Management

- Tariff structure definition
- Rate Price definition
- Tariff category
- Tax percentage
- Fixed Charge value
- Minimum charge value
- Slab reset period
- Tariff change administration

8.1.4 Limit Parameters management

- Define Load Limit
- Current Limit value
- Emergency Credit

Debt (previous charges) Management

8.1.5 Transaction management :

- Cash vend transaction
- Retained credit transaction
- Refund Money Transaction
- Previous Charge Transaction

8.1.6 Reports

- Debt collection and outstanding report
- Tax and duties accounts report
- Customer's Vend Report

8.1.7 Import of data by the vending station from the master station / Export of data by the main station to the vending stations:

- Import of data from Comma separated values(CSV) format files
- Export of data in CSV format.

8.1.8 User Security Management

- Group rights definition
- Entry of system users and allocation of group rights

9. SECURITY ASPECT:

The vending system shall be a sophisticated system with reliable security features.

a) The token created for particular meter with the defined tariff shall not be used for any other meter.

b) The meter shall accept the valid token only once. The token generated shall be meter specific and shall be used only on the particular meter for which it is intended.

c) The token shall not be reusable

d) The token shall be re-issued in case it is lost the meter shall accept the code generated only once.

e) Whenever a tariff change takes place no other token shall be accepted by the meter unless the updated tariff token is entered into the meter.

f) The token generated shall be authenticated as well as encrypted so that no decoding is possible.

- **The complete system and meter shall be guaranteed/warranty for 5 year from date of receipt of material at BHEL store.**
- **Vending server transaction charges for energy meter for no. coupons per Meter annually for 5 Years should be included in offer.**
- **Bidder/firm should visit site for actual requirement /condition before quoting in aforesaid Tender.**