MATERIAL SPECIFICATIONS CELL

TECHNICAL SPECIFICATION

LT AC THREE PHASE, FOUR WIRE 10 - 40 AMPS STATIC ENERGY METER WITH 6LOWPAN BASED INTERNAL LOW POWER RADIO FREQUENCY CONNECTIVITY FOR COMMUNICATION.

TECHNICAL SPECIFICATION NO.

CE / MMC / MSC – II / LPRF / 6LoWPAN /,

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1.00 SCOPE

This specification covers the design, engineering, manufacture, assembly stage testing, inspection and testing before dispatch and supply of ISI marked LT AC, Three Phase, Four wire, 10 - 40 Amps Static TOD Tri – vector Energy Meters with Communication capability based on 6LoWPAN Internal Low Power Radio Frequency (LPRF)) with Two Way Communication to read the meter data suitable for measurement of Active Energy (kWh), Reactive Energy(kVArh Lag and kVArhLead separately)and kVAMD in three phase, four wire balanced / unbalanced loads of LT residential and commercial consumers.

The meter shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to purchaser, who will interpret the meaning of drawings and specification and shall have the power to reject any work or material which, in his judgment is not in accordance therewith. The offered material shall be complete with all components necessary for their effective and trouble free operation. Such components shall be deemed to be within the scope of Bidder's supply irrespective of whether those are specifically brought out in these specifications and / or the commercial order or not.

2.00 QUALIFYING REQUIREMENTS

2.01 Offers of only original manufacturers of LT AC Static Energy Meter shall be accepted against the Tender.

2.02 The following qualifying requirement shall be fulfilled by the bidders / manufacturers.

(a) The bidder / manufacturer shall have turnover of `80.00 Crores during any one of the last three financial years.

(b) The bidder / manufacturer shall have supplied 12.5 Lakhs static meters during the last three financial years.

(c) The bidder / manufacturer shall have minimum experience of three years of supply or manufacturing for static meter upto the end of the last financial year.

2.03 The offers of Indian subsidiary company, whose parent company is located abroad fulfilling the qualifying requirements, shall be considered provided the Indian participant subsidiary company fulfils the minimum experience of three years of supply or manufacturing for static energy meter upto the end of the last financial year. However, the conditions of turnover of `80.00 Crores during any one of the last three financial years and supply of minimum quantity of 12.50 Lakhs static energy meter during last three

financial years can be fulfilled by the parent company located in abroad on behalf of their Indian subsidiary company. The parent company shall furnish undertaking for accepting responsibility for supplying quality meter as per specifications and execution of the contract on behalf of its India based subsidiary unit who has participated in the tender in Annexure - U-I.

2.04 In case of offers of foreign bidders / manufacturers, they shall fulfill Qualifying Requirement as per Sr. No. 2.02 (a) and 2.02 (b) above.

2.05 **MINIMUM TESTING FACILITIES:**

Manufacturer shall posses fully computerized Meter Test Bench System for carrying out routine and acceptance Tests as per IS: 13779 / 1999 (amended up to date). In addition, this facility shall produce Test Reports for each and every meter. The list of testing equipments shall be enclosed. The manufacturer shall have the necessary minimum testing facilities for carrying out the following tests:

a) Insulation resistance measurement

b) No load condition

c) Starting current test

d) Accuracy requirement

e) Power consumption in voltage circuit

f) Repeatability of error

g) Glow Wire Testing facility.

h) Transportation test – as per specification

i) Tamper conditions - as per specification.

j) LPRF Communication Connectivity Test as per specification.

k) The manufacturer shall have duly calibrated RSS meter of class 0.1 or better accuracy. The bidder shall have fully automatic Test Bench having in-built constant voltage, current and frequency source with facility to select various loads automatically and print the errors directly.

2.06 **METER SOFTWARE**

The Bidders will have to get appraised & obtain CMMI – Level III within one year from date of letter of award.

2.07 Notwithstanding anything stated herein under, the Purchaser reserves the right to assess the capacity and capability of the bidder to execute the work, shall the circumstances warrant such assessment in the overall interest of the Purchaser.

3.00 STANDARDS TO WHICH METERS SHALL COMPLY:

IS: 13779 / 1999 amended upto date and other relevant IS specifications including CBIP Tech report 88 amended upto date,

CEA regulations and MERC guidelines with latest amendments.

IS: 15707 / 2006: Specification for Testing, evaluation, installation & maintenance of AC Electricity Meters-Code of Practice.

The specification given in this document supersedes the relevant clauses of IS: 13779 / 1999 (amended up to date) wherever applicable.

The equipment meeting with the requirements of other authoritative standards, which ensures equal or better quality than the standard mentioned above, also shall be considered. For conflict related with other parts of the specification, the order of priority shall be – (i) this technical specification, (ii) IS: 13779 / 1999 amended upto date.

The Common Meter Reading Instrument (CMRI) shall conform to following relevant standards.

a) CBIP Tech. Report 88 (amended upto date)

b) IS: 13779 / 1999: Specification for AC Static Watt-hour meters class 1 and 2.

c) IEC 687 / 1992: Alternating Current Static Watt-hour meters for active energy Class 0.5S and 0.2S.

d) IEC 1036 / 1996: Alternating Current Static Watt-hour meters for active energy (Class 1 and 2)

e) IEC 529: Degree of protection provided by enclosures.

f) IS: 12063 / 1987: amended upto date: Classification of degrees of protection provided by enclosures of electrical equipment.

g) IS: 9000/1979: Basic environmental testing procedures for electronic and electrical items.

h) IEC 1000: Electromagnetic compatibility.

i) IEC 1000-4-2/1995: Electrostatic discharge immunity test.

j) CISPAR 22: Limits and method of measurement of radio disturbance characteristics of information technology equipment.

k) IEC 1000-4-3/1995: Radiated radio frequency electromagnetic field immunity test.

4.00 SERVICE CONDITIONS:

As per IS: 13779 / 1999 (amended upto date), the meter to perform

satisfactorily under Non - Air Conditioned environment (within stipulations of IS).

Meter body shall conform to IP 51 degree of protection. For outdoor use, meter shall be installed in sealed enclosure conforming to IP 55.

The meter shall be suitably 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 provided suitable protection to them from any injurious effect of excessive humidity.

The meter to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions:

Environmental Conditions

a) Maximum ambient temperature 55^0C

b) Maximum ambient temperature in shade 45^0C

c) Minimum temperature of air in shade 35^0C

d) Maximum daily average temperature 40^0C

e) Maximum yearly weighted average temperature 32^0C

f) Relative Humidity 10 to 95 %

g) Maximum Annual rainfall 1450 mm

h) Maximum wind pressure 150 kg/m^2

i) Maximum altitude above mean sea level 1000 meter

j) Isoceraunic level 50 days/year

k) Seismic level (Horizontal acceleration) 0.3 g

l) Climate: Moderately hot and humid tropical climate conducive to rust and fungus growth.

5.00 GENERAL TECHNICAL REQUIREMENTS:

1	TYPE	LT AC three phase, four Wire Static TOD Tri-Vector Energy Meter with communication capability based on Internal Low Power Radio Frequency (LPRF) suitable for three phase, four wire balanced / unbalanced loads of LT Consumers.
2	ACCURACY CLASS	1.0 (FOR ACTIVE AND REACTIVE ENERGY)

3	CURRENT RATING	10 – 40 Amps
4	RATED BASIC CURRENT (Ib)	10 Amps per phase
5	MAXIMUM CONTINUOUS CURRENT (Imax)	4 times (400 %) of Ib. The meter shall work accurately at 150% of Imax.
6	STARTING CURRENT	0.2% of Ib.
7	SHORT TIME CURRENT	As per IS 13779 / 1999.
8	RATED VOLTAGE	3 x 240 Volts Ph-N
9	VOLTAGE RANGE	+ 20 % to – 40 % of rated voltage.
10	TEMPERATURE	The standard reference temperature for performance shall be 27^0C. The mean temperature co-efficient shall not exceed 0.07%.
11	FREQUENCY	50 Hz ± 5%
12	POWER FACTOR	Power Factor range: Zero Lag to unity to Zero Lead to unity Avg. P.F = $\frac{\text{Total(kWh)}}{\text{Total (kVAh)}}$ $kVAh = \sqrt{(Kwh)^2 + (RKVAhlag + RKVAhlead)^2}$
13	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 10 VA. (ii) The apparent power taken by each current circuit, at basic current Ib, reference frequency and reference temperature shall not exceed 4 VA.
14	DESIGN	Meter shall be designed with application specific integrated circuit (ASIC) or micro controller; shall have no moving parts;

		electronic components shall be assembled on printed circuit board using surface mounting technology; factory calibration using high accuracy (0.1 class) software based test bench.
15	POWER SUPPLY	SMPS
16	ISI MARK	The meter so supplied must bear ISI Mark.

6.00 CONSTRUCTIONAL REQUIREMENT / METER COVER & SEALING ARRANGEMENT

6.01 GENERAL MECHANICAL REQUIREMENT

The meter shall be designed and constructed in such a way as to avoid introducing any danger in normal use and under normal conditions, so as to ensure especially:

(a) personal safety against electric shock:

(b) personal safety against effects of excessive temperature;

(c) protection against spread of fire;

(d) protection against penetration of solid objects, dust and water in the meter.

6.02 All parts, which are subject to corrosion under normal working conditions, shall be protected effectively against corrosion by suitable method to achieve durable results. Any protective coating shall not be liable to damage by ordinary handling nor damage due to exposure to air, under normal working conditions. The electrical connections shall be such as to prevent any opening of the circuit under normal conditions of use as specified in the standard, including any overload conditions specified in the standard. The construction of the meter shall be such as to minimize the risks of short-circuiting of the insulation between live parts and accessible conducting parts due to accidental loosening or unscrewing of the wiring, screws, etc. The meter shall not produce appreciable noise in use.

6.03 All insulating materials used in the construction of the meter shall be substantially non-hygroscopic, non ageing and of tested quality.

6.04 The meter shall be projection type and shall be dust and moisture proof. The meter base & cover shall be made out of unbreakable, high grade, fire resistant Polycarbonate material so as to give it tough and non-breakable qualities. Meter base shall be opaque and meter top cover shall be transparent. The meter cover shall be secured to base by means of sealable unidirectional captive screws. The meter body shall be type tested

for IP51 degree of protection as per IS 12063 against ingress of dust, moisture & vermin but without suction in the meter.

6.05 **METER CASE**

6.05.01 The poly carbonate body of the meter shall conform to IS: 11731 (FV-2 category) 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-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.

6.05.02 The base and cover shall be ultra-sonically welded (continuous welding) so that once the meters are manufactured and tested at factory; it shall not be possible to open the cover at site except the terminal cover. The thickness of material for meter cover and base shall be 2 mm (minimum).

6.06 **TERMINALS & TERMINAL BLOCK**

6.06.01 Moulded terminal block for current and voltage connections conforming to IS: 13779 / 1999 (amended up to date) to meet the requirement of terminal connection arrangement shall be provided. The termination arrangement shall be with an extended transparent terminal cover as per clause number 6.5.2 of IS: 13779 / 1999 and shall be sealable independently to prevent unauthorized tampering. Proper size of grooves shall be provided at bottom of this terminal cover for incoming and outgoing service wires.

6.06.02 The terminal cover shall be extended transparent type and shall enclose the actual terminals, the conductor fixing screws and unless otherwise specified, a suitable length of external conductors and their insulation.

6.06.03 The fixing screws used on the terminal cover for fixing and sealing in terminal cover shall be held captive in the terminal cover.

6.06.04 When the meter is mounted, no access to the terminals shall be possible without breaking seals(s) of the terminal cover.

6.07 Sealing provision shall be made against opening of the terminal cover and front cover. It is necessary to provide screws with two holes for sealing purpose. The meter shall be pilfer-proof & tamper-proof. The provision shall be made on the Meter for at least two seals to be put by utility user.

6.08 The meter shall be completely factory sealed except the terminal block cover. The provision shall be made on the meter for at least two seals to be put by utility user. The Terminal cover shall be transparent with one side hinge with sealing arrangement

6.09 **RESISTANCE TO HEAT AND FIRE**

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

6.10 **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 front. The test output device shall be provided in the form of blinking LED. The pulse rate of output device (separate blinking LED must be provided for each parameter) which is Pulse / kWh andPulse / kVArh(meter constant) shall be indelibly provided on the nameplate. It shall be possible to check the accuracy of active energy and reactive energy measurement of the meter on site by means of LED output. Resolution of the test shall be sufficient to enable the starting current test in less than 10 minutes and accuracy test at the lowest load shall be completed with desired accuracy within 5 minutes.

6.11 The meter accuracy shall not be affected by magnetic field (AC / DC / Permanent) upto 0.2 Tesla on all the sides of meter, i.e. front, sides, top and bottom of the meter as per CBIP Technical Report 88 with latest amendments. Under influence of any magnetic field (AC / DC / Permanent) above 0.2 Tesla, if the accuracy of the meter gets affected, then the meter shall record energy considering Imax and reference voltage at unity power factor.

6.12 The meter shall have CTs with magnetic shielding and same shall be tested separately prior to assembly.

6.13 In meter, Power supply unit shall be micro control type (transformer less to avoid magnetic influence) instead of providing conventional transformer and then conversion to avoid magnetic influence.

6.14 **REAL TIME INTERNAL CLOCK (RTC):**

The real time quartz clock shall be used in the meter for maintaining time (IST) and calendar. The RTC shall be non - rechargeable and shall be pre-programmed for 30 Years Day / date without any necessity for correction. The maximum drift shall not exceed +/- 300 Seconds per year. Facility for adjustment of real time shall be provided through CMRI with proper security.

The clock day / date setting and synchronization shall only be possible through password / Key code command from CMRI or Meter testing work bench and this shall need password enabling for meter.

The RTC battery & the battery for display in case of power failure shall be separate.

6.15 Non-specified display parameters in the meter shall be blocked and same shall not be accessible for reprogramming at site through any kind of communication

6.16 Complete metering system & measurement shall not be affected by the external electromagnetic interference such as electrical discharge of cables and capacitors, harmonics, electrostatic discharges, external magnetic fields and DC current in AC supply etc. The Meter shall meet the requirements of CBIP Tech-report 88 (amended up to date).

6.17 A push button shall be provided for high resolution reading with two decimal digits / alternate mode of display as brought out elsewhere in this specification.

6.18 **SELF DIAGNOSTIC FEATURES**:

(a) The meter shall keep log in its memory for unsatisfactory / non - functioning of Real Time Clock battery.

(b) LCD Test display shall be provided for checking of all display Segments.

6.19 The meter shall have facility to read the default display parameters during power supply failure. An internal maintenance free battery (Ni-mh or Li-ion or NI CD) of long life of 10 years shall be provided for the same. A suitable Push Button arrangement for activation of battery shall be provided. Alternatively, push button provided for displaying alternate mode (On Demand Mode) parameters shall also be acceptable for activation of battery during power OFF condition.

After activating the battery during power OFF condition, the meter shall display all default parameters only once, after which the battery shall switch OFF automatically. The battery shall be locked after 3 successive operations during one power OFF cycle. As soon as the supply is resumed to meter, the battery shall automatically come to normal.

6.20 PCB used in meter shall be made by Surface Mounting Technology.

6.21 The meter shall also be capable to withstand and shall not get damaged if phase to phase voltage is applied between phases to neutral for 5 minutes.

6.22 The meter shall record and display total energy including Harmonic energy.

6.23 **COMMUNICATION CAPABILITY:**

The meter shall have wireless communication with HHT, for downloading all types of data from the meter. Meter shall support 6LoWPAN based on Internal Low Power Radio Frequency (LPRF) technology on frequency band sub-1GHz. HHT shall support dual band operations i) Zigbee based 2.4 GHz ii) 6LoWPAN based sub-1 GHz. HHT shall be capable to download, commission Zigbee based and 6LoWPAN based LPRF meters. Download should be possible though **optical port** in case of power failure. The baud rate while downloading data through optical port should be 9600. Bidder

should implement their own protocol using attributes defined in annexure-V for data downloading through optical port.

6.23.01 **6LoWPAN BASED INTERNAL LOW POWER RADIO FREQUENCY (LPRF)**

The 6LoWPAN based Internal Low Power Radio Frequency (LPRF) shall be capable to read the meter from a distance of minimum one hundred (100) meter with line of sight radius without obstructions, from the meter. Longer communication range is preferred.

The Meter & HHT shall be based on 6LoWPAN networking on sub-1 GHz (865-867 MHz) with protocol enclosed herewith as Annexure IV & V for Interoperability with following settings:

1. Device shall be capable of being 6LoWPAN 'root' device. Default device type at factory defaults should be 'router' and state is 'not joined'.
2. Default PAN id shall be 0xFFFF.
3. Radio device shall have 128 bits addressing (as per IPv6 and Annexure-V.)
4. The radio shall be programmed with 16 byte security key (128 bit encryption). The value for sample = '0000000000MSEDCL'(ASCII) (This value is only for samples and actual value will be informed to successful bidder.)
5. The baud rate for radio to meter UART shall be 9,600 bps.
6. Over the air baud rate shall be 50 kbps.
7. Following Commissioning attributes must be supported:
   i. PAN ID
   ii. Channel (0-8)
   iii. Device Type (1- Root, 2-Router)
   iv. IPv6 Prefix (as per IPv6 Specifications)
   v. AES key – 16 Bytes Hex
   vi. Commission state (0- un-commissioned, 1- commissioned)
   vii. DAG ID – 16 Byte (as per IPv6 specifications)
   viii. Router List
8. The HHT shall be capable of commissioning a meter network node as either a 6LoWPAN 'root' or 'router' as appropriate.
9. The HHT shall be capable of joining a metering network as a Router / end device to download data.

6.23.02 ZIGBEE BASED INTERNAL LOW POWER RADIO FREQUENCY (LPRF)

The Zigbee based Internal Low Power Radio Frequency (LPRF) shall be capable to read the meter from a distance of minimum thirty (30) meter radius with obstructions from the meter. Longer communication range is preferred. However, no pre - installation programming or post installation programming shall be required for this purpose.

The HHT shall be based on Open ZigBee - 2007 PRO with Smart energy profile protocol enclosed herewith as Annexure IV & V for Interoperability with following settings:

1. PAN id shall be 123 (This id is only for samples and actual id will be informed to successful bidder.)
2. Radio device shall have 64 bits addressing (as per IEEE.802.15.4 standard.)
3. The radio shall be programmed with 16 byte security key (128 bit encryption). The value for sample = 'MSEDCL' (This value is only for samples and actual value will be informed to successful bidder.)
4. The baud rate for radio to meter UART shall be 9,600 bps.
5. Over the air baud rate shall be 250 kbps.
6. Meter Serial Number shall be mapped with 64 bit MAC address of the radio.
7. The sample metering cluster 0x0702 to be implemented as open protocol as per Annexure V.
8. The meter network RF device shall be a combo device.
9. The HHT shall be a combo device.
10. The HHT shall be capable of commissioning a meter network node as either a coordinator or router as appropriate.
11. The HHT shall be capable of joining a metering network as a Router / end device to download data.
12. The profile used shall be OxBFOD.
13. Source and Destination Device End Point 0x08
14. Channel Mask 0x03FFF800 (not support the last channel number 26 in the band)
15. Time attribute to be supported as per Annexure V.
16. Following Commissioning attributes must be supported:
    i. Preconfigured Link Key
    ii. Channel Mask

iii. Startup control

iv. Extended PAN ID

17. Following cluster support need to be present in Zigbee module:

i. Basic Cluster 0x0000

ii. Commissioning Cluster 0x0015

iii. MSEDCL Cluster 0xFC00

The bidder shall submit Zigbee compliance certificate for radio modules used in the HHT. Likewise, the certificate of PICS (Protocol Implementation & Conformance Statement) in regards Manufacturer Specific Cluster from Zigbee Alliance Official Test House shall be submitted.

The frequency range of LPRF equipment shall be approved frequency range from Government of India, Ministry of Communications and Information Technology (Wireless Planning and Coordination Wing) New Delhi notification vide G.S.R. 45 (E), dtd. 28th January, 2005, i.e. the frequency band of 2.4GHz and 865 – 867 MHz. The meter shall use license free frequency band for communication so that license for use of LPRF equipment to read energy meter at site is not required. The required license, if any, for use of LPRF equipment to read energy meter at the site shall not be under the scope of purchaser. The necessary support shall be provided by the tenderer. Accordingly, Bidder shall submit ETA (Equipment Type Approval) for RF Module, issued by WPC Wing (Wireless planning and co-ordination wing) of Ministry of Communications and Information Technology, Govt. of India.

The meters with Internal Low Power Radio Frequency (LPRF) technology shall have two way communication to read the meter data. However, data could only be downloaded from meter to HHT, but no command regarding data alteration in the meter and data retrieval from meter to HHT shall be possible in any case. The LPRF module of the meter shall have no physical access from outside the meter. It shall not be possible to tamper the data stored in meter and HHT even after getting the password of the software. It shall be locked at the time of manufacturing. Adequate tamper proofing shall be provided to disallow any change of such auto recorded reading by any means. Meter shall not be accessible for reprogramming at site through any kind of communication for any alteration in the factory settings. Tamper proof arrangement shall be made to get such a reading even at the time of power failure. Meter shall support communication through Optical port in the event of Power failure, through battery.

6.24 The meter shall be supplied with battery back up feature for displaying the parameters during power OFF condition. Battery life shall be minimum ten years.

Separate push button shall be provided for activation of battery during power OFF condition. Alternatively, push button provided for displaying alternate mode (On Demand Mode) parameters shall also be acceptable for activation of battery during power OFF condition.
After activating the battery during power OFF condition, the meter shall display all Default Display (Auto Scrolling Mode) parameters only once, after which the battery shall switch OFF automatically. The battery shall be locked after 3 operations during one power OFF cycle.

6.25 The accuracy of the meter and the measurement by meter shall not get influenced by injection of high frequency AC Voltage / chopped signal / DC signal and harmonics on the terminals of the meter. The meter accuracy shall not be affected by magnetic field from all sides of the meter i.e. front, sides, top and bottom of the meter.

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

a) On any of the phases or neutral terminals

b) On any connecting wires of the meter (Voltage discharge with 0-10 mm spark gap)

c) At any place in load circuit

d) Anywhere on meter body

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

6.27 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.

6.28 Wire / cable less design: The meter PCB shall be wireless to avoid improper soldering & loose connection / contact.

6.29 The meter shall record and display total energy including Harmonic energy.

6.30 A sticker label containing warning notice in Marathi language which is to be stick up on meters front cover or printed on meter name plate with easily readable font size not less than 10 in red colour, which reads as “ **सावधान ! "मीटरला फेरफार करण्याचा प्रयत्न केल्यास अधिकतम वेगाने वीज नोंदणीहोणार "**

7.00 TOD TIMINGS

There shall be provision for at least 6 (Six) TOD time zones for energy and demand. The number and timings of these TOD time Zones shall be

programmable. At present the time zones shall be programmed as below.

Zone "A": - 00:00 Hrs. to 06:00 Hrs. and 22:00 Hrs. to 24:00 Hrs.

Zone "B": - 06:00 Hrs. to 09:00 Hrs. and 12:00 Hrs. to 18:00 Hrs.

Zone "C": - 09:00 Hrs. to 12:00 Hrs.

Zone "D": - 18:00 Hrs. to 22:00 Hrs.

8.00 DEMAND PERIOD

The maximum demand integration period shall be set at 30 minutes sliding window method (Sub Integration period of 10 minutes) and can be set at 15 minutes programmable (Sub Integration period of 5 minutes), if required in future.

9.00 MD RESET:

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

a) Communication driven reset through hand held terminal (HHT).

b) Auto reset at 24:00 hrs at the end of each billing cycle: Automatic reset at the end of certain predefined period (say, end of the month). No push button shall be provided for MD reset.

10.00 ANTI TAMPER FEATURES

The meter shall detect and correctly register energy in forward direction under following tamper conditions.

10.01 Change of phase sequence:

The meter accuracy shall not be affected by change of phase sequence. It shall maintain the desired accuracy in case of reversal of phase sequence.

10.02 Reversal of line and load terminals:

Even on interchanging the load and line wires, the meter shall register correct energy passing through the meter.

10.03 Drawing of current through local Earth:

The meter shall register accurate energy even if load is drawn partially or fully through a local earth.

10.04 The three phase meter shall continue to work even without neutral.

10.05 The three phase meter shall work in absence of any two phases i.e. it shall work on any one phase wire and neutral, to record relevant energy.

10.06 The meter shall work without earth.

10.07 The potential link shall not be provided.

10.08 Visual indication shall be provided to safeguard against wrong connections to the meter terminals.

10.09 The meter accuracy shall not be affected by external AC / DC / permanent magnetic field upto 0.2 Tesla as per CBIP Technical Report 88 with latest amendments. If the meter gets affected under influence of any magnetic field (AC / DC / Permanent) above 0.2 Tesla, then the same shall be recorded as magnetic tamper event with date & time stamping and the meter shall record energy considering Imax and reference voltage at unity power factor.

11.00 TAMPER EVENTS:

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 detection of the tamper event shall be registered in the tamper event register. The no. of times the tampering has been done shall also be registered in the meter. It is the responsibility of the meter manufacturer not to use manufacturer specific codes where standard codes are available.

The meter shall have features to detect the occurrence and restoration of the following abnormal events.

11.01 **Missing potential and potential imbalance:**

The meter shall be capable of detecting and recording occurrence and restoration with date and time the cases of potential failure and low potential, which could happen due to disconnection of potential leads (one or two) with phase identification. Meter shall also detect and log cases of voltage unbalance (10% or more for 5 Minutes.) Higher of the 3 phase voltages shall be considered as reference for this purpose.

11.02 **Current unbalance**:

The meter shall be capable of detecting and recording occurrence and restoration with date and time of current unbalance (30% or more for 15 minutes) with phase identification. Higher of the 3 phase currents shall be considered as reference for this purpose.

11.03 **Current Reversal**:

The meter shall be capable of detecting and recording occurrence and restoration with date and time of reversal of current with phase identification for persistence time of 5 minutes. It shall also possess a current reversal counter.

11.04 **Current circuit short**:

The meter shall be capable of detecting and recording occurrences and

restoration of shorting of any one or two phases of current, with date & time of occurrence and restoration with phase identification.

11.05 **High Neutral Current. (CT bypass):**

The meter shall be capable of recording incidences of excess neutral current (if it is in excess 30% of Ib for more than 5 minutes.) The meter shall record the total duration of the above abnormalities, time and date of their occurrences and restorations with snapshot of instantaneous electrical conditions viz. System Voltages, Phase Currents & System PF.

11.06 **Power ON / OFF:**

The meter shall be capable to record power ON/OFF events in the meter memory. All potential failure shall record as power off event.The meter shall keep records for the minimum 256 events in the meter memory for retrieval by authorized personnel. (Occurrence + Restoration with date & time).

For above abnormal conditions, the recording of events shall be on FIFO basis. The unrestored events shall be recorded separately and shall not be deleted till they get recovered (permissible upto 3 months). It shall be possible to retrieve the abnormal event data through the meter RF port with the help of HHT& downloaded the same to the base computer. All the information shall be made available in simple & easy to understand format**.**

11.07 In the event the meter is forcibly opened, even by 2 to 4 mm 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. It is suggested that the manufacturer should develop their software such that there will be some time delay for activation of this tamper feature and during that period only the meter cover should be fitted. The delay in activation of software shall be for one instance only. After the meter cover is fitted, it shall get activated immediately with out any delay.

12.00 DISPLAY OF MEASURED VALUES

12.01 The meter shall have minimum 5 digits (with ± indication), parameter identifier, permanently backlit Liquid Crystal Display (LCD) with wide viewing angle and shall be visible from the front of the meter. The display shall be electronic and when the meter is not energized, the electronic display need not be visible. The size of digit shall be minimum 10x5 mm. The decimal units shall not be displayed in auto scroll mode. However it shall be displayed in push button mode for high resolution display for testing. LCD shall be suitable for temperature withstand of 70^0 C. Adequate back up arrangement for storing of energy registered at the time

of power interruption shall be provided.

In case of multiple values presented by single display, it shall be possible to display the contents of all relevant memories. When displaying the memory, the identification of each parameter applied shall be possible. The principle unit for measured values shall be the kilowatt-hour (kWh) for active energy, kVArh for reactive energy &kVAh for apparent energy.

12.02 The meter shall be pre-programmed for following details.

(a) P. T. Ratio: 415 V

(b) MD Integration Period: 30 Minutes real time based.

(c) The meter shall Auto reset kVAMD at 24.00 Hrs. of last day of the month and this value shall be stored in the memory along with the cumulative kWh and cumulative kVAh reading.

(d) No MD reset push button shall be provided.

(e) Average power factor with 2 decimal digits shall be displayed.

(f) The Default Display shall switch to Alternate Display (On Demand Display Mode) after pressing the push button continuously for 5 seconds.

(g) The meter display shall return to Default Display Mode if the "On Demand" Push Button is not operated for 15 sec.

(h) The array of data to be retained inside the meter memory shall be for the last 60 days for a capture period of 30 minutes. The load survey data shall be first in first out basis (FIFO).

(i) The sequence of display of various instantaneous electrical parameters in auto scroll & On Demand mode shall be as below. Display other than specified below shall be blocked. The scroll period for auto scroll, if any, shall be 9 sec.

(A)	**Default Display**
1.	LCD Test
2.	Meter Sr. No.
3.	Real Time Clock – Date & Time
4.	Cumulative Energy – kWh
5.	Cumulative Energy – kWh - TOD Zone A (TZ1)
6.	Cumulative Energy – kWh - TOD Zone B (TZ2)

7.	Cumulative Energy – kWh - TOD Zone C (TZ3)
8.	Cumulative Energy – kWh - TOD Zone D (TZ4)
9.	Cumulative Energy – kVArh - Lag
10.	Cumulative Energy – kVArh - Lag- TOD Zone A (TZ1)
11.	Cumulative Energy – kVArh - Lag- TOD Zone B (TZ2)
12.	Cumulative Energy – kVArh - Lag- TOD Zone C (TZ3)
13.	Cumulative Energy – kVArh - Lag- TOD Zone D (TZ4)
14.	Cumulative Energy –kVArh - Lead
15.	Cumulative Energy – kVArh - Lead- TOD Zone A (TZ1)
16.	Cumulative Energy – kVArh - Lead- TOD Zone B (TZ2)
17.	Cumulative Energy – kVArh - Lead- TOD Zone C (TZ3)
18.	Cumulative Energy – kVArh - Lead- TOD Zone D (TZ4)
19.	Cumulative Energy – kVAh
20.	Cumulative Energy – kVAh - TOD Zone A (TZ1)
21.	Cumulative Energy – kVAh - TOD Zone B (TZ2)
22.	Cumulative Energy – kVAh - TOD Zone C (TZ3)
23.	Cumulative Energy – kVAh – TOD Zone D (TZ4)
24.	Current MD – kVA with occurance date & time
25.	MD - kVA – TOD Zone A (TZ1) with occurance date & time
26.	MD - kVA – TOD Zone B (TZ2) with occurance date & time
27.	MD - kVA – TOD Zone C (TZ3) with occurance date & time
28.	MD - kVA – TOD Zone D (TZ4) with occurance date & time
29.	Number of MD – kVA reset
30.	Rising MD with elapsed time

31.	Three Phase Power Factor – PF
32.	Cumulative Tamper Count
33.	Meter Cover Opening –Occurance with date and time.
(B)	**On – Demand Display (Alternate Display)**
1.	Meter Sr. No.
2.	Last date & time of MD - kVA reset
3.	Current – I_R
4.	Current – I_Y
5.	Current – I_B
6.	Voltage – V_R
7.	Voltage – V_Y
8.	Voltage – V_B
9.	Signed Power Factor – R Phase
10.	Signed Power Factor – Y Phase
11.	Signed Power Factor – B Phase
12.	Frequency
13.	High resolution kWh (for calibration)
14.	High resolution kVArh Lag(for calibration)
15.	High resolution kVArh Lead(for calibration)
16.	High resolution kVAh (for calibration)
17.	Rising MD with elapsed time (for calibration/testing)
18.	M1 MD - kVA – TOD Zone A (TZ1) with occurance date & time
19.	M1 MD - kVA –TOD Zone B (TZ2) with occurance date & time
20.	M1 MD - kVA – TOD Zone C (TZ3) with occurance date & time

21.	M1 MD - kVA – TOD Zone D (TZ4) with occurance date & time
22.	M2 MD - kVA – TOD Zone A (TZ1) with occurance date & time
23.	M2 MD - kVA –TOD Zone B (TZ2) with occurance date & time
24.	M2 MD - kVA – TOD Zone C (TZ3) with occurance date & time
25.	M2 MD - kVA – TOD Zone D (TZ4) with occurance date & time
26.	Last Tamper Event with date and time.
27.	PAN ID of meter
28.	Voltage – V_R (Instantaneous)
29.	Voltage – V_Y (Instantaneous)
30.	Voltage – V_B (Instantaneous)
31.	Current – I_R (Instantaneous)
32.	Current – I_Y (Instantaneous)
33.	Current – I_B (Instantaneous)
34.	Active Power- kW-R phase (Instantaneous)
35.	Active Power- kW-Y phase (Instantaneous)
36.	Active Power- kW-B phase (Instantaneous)
37.	Reactive Power- kVAr- R phase (Instantaneous)
38.	Reactive Power- kVAr- Y phase (Instantaneous)
39.	Reactive Power- kVAr- B phase (Instantaneous)
40.	Apparent Power- kVA- R phase (Instantaneous)
41.	Apparent Power- kVA- Y phase (Instantaneous)
42.	Apparent Power- kVA- B phase (Instantaneous)
43.	Frequency (Instantaneous)
44.	Phase Sequence (Instantaneous)

13.00 DEMONSTRATION

The purchaser reserves the right to ask to give the demonstration of the equipment offered at the purchaser's place.

14.00 BILLING DATA, BILLING HISTORY & LOAD SURVEY

14.01 BILLING DATA

Billing parameters shall be downloaded as per table below.

(1)	Cumulative Energy –kWh
(2)	Cumulative Energy –kWh-TOD Zone A (TZ1)
(3)	Cumulative Energy –kWh-TOD Zone B (TZ2)
(4)	Cumulative Energy –kWh-TOD Zone C (TZ3)
(5)	Cumulative Energy –kWh-TOD Zone D (TZ4)
(6)	Maximum Demand- MD kVA with occurrence date & time
(7)	MD kVA- TOD Zone A (TZ1) with occurrence date & time
(8)	MD kVA- TOD Zone B (TZ2) with occurrence date & time
(9)	MD kVA- TOD Zone C (TZ3) with occurrence date & time
(10)	MD kVA- TOD Zone D (TZ4) with occurrence date & time
(11)	Cumulative Energy –kVAh
(12)	Cumulative Energy –kVAh-TOD Zone A (TZ1)
(13)	Cumulative Energy –kVAh-TOD Zone B (TZ2)
(14)	Cumulative Energy –kVAh-TOD Zone C (TZ3)
(15)	Cumulative Energy –kVAh-TOD Zone D (TZ4)
(16)	Cumulative Energy –kVArh (Lag)
(17)	Cumulative Energy –kVArh (Lead)
(18)	Voltage – V_{RN}
(19)	Voltage – V_{YN}
(20)	Voltage – V_{BN}

(21)	Current - I_R
(22)	Current – I_Y
(23)	Current – I_B

14.02 **BILLING HISTORY**

The meter shall have sufficient non-volatile memory for recording history of billing parameters (Cumulative kWh Total, Cumulative kVAh Total, Cumulative kVArh (Lag), Cumulative kVArh (Lead) at the time of reset and kVAMD) for last 12 months.

14.03 **LOAD SURVEY**

The logging interval for load survey shall be 30 minutes. Load survey data shall be logged for last 60 days on non time based basis, i.e. if there is no power for more than 24 hours, the day shall not be recorded. Whenever meter is taken out and brought to laboratory, the load survey data shall be retained for the period of actual use of meter. This load survey data can be retrieved as and when desired and load profiles shall be viewed graphically / analytically with the help of meter application software. The meter application software shall be capable of exporting / transmitting these data for analysis to other user software in spreadsheet format.

Sr. No.	**Parameters**
1.	Real Time Clock – Date & Time
2.	Current - I_R
3.	Current – I_Y
4.	Current – I_B
5.	Voltage – V_{RN}
6.	Voltage – V_{YN}
7.	Voltage – V_{BN}
8.	Block Energy – kWh
9.	Block Energy – kVArh – lag
10.	Block Energy – kVArh – lead
11.	Block Energy – kVAh

15.00 COMPUTER SOFTWARE

15.01 For efficient and speedy recovery of data downloaded through HHT on base computer, licensed copies of base computer software shall be supplied free of cost.

15.02 This BCS software shall be password protected.

15.03 The computer software shall be "Windows" based of latest version & user friendly & shall support all versions of “Windows”. Also whenever there is new upgrade version operating system is released, the computer software compatible to that version should be provided within 3 months free of cost.

15.04 The data transfer from meter to HHT & from HHT to laptop computer or PC shall be highly reliable and fraud proof.

No editing shall be possible on base computer as well as on HHT by any means.

15.05 This software shall be used at number of places up to Division / Sub Division level. Hence as many copies of base computer software as required up to Division / Sub Division level shall be provided by supplier.

15.06 BCS software shall have the facility to import consumer master data from MSEDCL billing system to BCS. Format is as follows:

Field	Data Type	Length
Billing Unit (BU)	Variable character	4
Processing Cycle (PC)	Number	2
Meter Route (MR)	Variable character	2
Route	Variable character	4
Sequence	Variable character	4
Consumer Number	Variable character	12
Consumer Name	Variable character	50
Consumer Address	Variable character	50
Meter Serial Number	Variable character	8
Meter Make Code	Variable character	3
Distribution Transformer Centre	Variable character	7

(DTC) code		
Bill Month (YYMM)	Variable character	4
Current reading	Variable character	6
Average consumption	Variable character	6
Meter Phase	Variable character	2
Meter Type (Zigbee/6LoWPAN)	Variable character	15

15.07 Import / Export shall happen on any USB port of PC / Laptop.

15.08 Every report shall have the facility to print/export as text, pdf.

15.09 Exporting of meter number from BCS to HHT shall be selective on meter number or group of meters of particular MR-Route-Sequence or DTC code.

15.10 The software shall have capability to convert all the data into ASCII format as per MSEDCL requirement as below.

a) Billing Data Format

(i) Reading captured from RF meters shall be submitted in one line per meter reading in following format for billing.

Parameter	Length	Position	Remark
Record Type	4 Char	01-04	RF01 / RF03 (Refer table of Record Types)
Consumer Number	12 chars	05-16	Left Padded with zeros (0)
Make Code	5 chars	17-21	As given in Annexure-III
Meter ID(Serial No)	8 chars	22-29	Left Padded with zeros (0)
Current Reading date	8 chars	30-37	DDMMYYYY format
Current kWh reading	8 chars	38-45	Left Padded with zeros (0)
Current kVA MD	4 chars	46-49	Left Padded with zeros (0) with decimal part if any
Current kVAMD date	8 chars	50-57	DDMMYYYY format
Current kVAMD time	4 chars	58-61	HHMI format

(ii) Last Line in bill string (Meter Reading) file, will be the check sum logic output as follows:

- Character 1 to 4 (4 characters): will be (RFT1 /RFT3).

(Refer table of record types)

- Character 5 to 12 (8 characters): Count of Meter Serial Number, left padding by 0.
- Character 13 to 28 (16 characters): Sum of KWh of all above meters. Total length will be 16, left padding with 0.
- Character 29 to 36 (8 characters): Sum of KW MD, total length will be 8, left padding with 0.
- Character 37 to 61 (25 characters): All zeros.

(iii) Table of Record Type

Source	Type	Record Type	Prefix Required
RF	Single Phase	Data	**RF01**
RF	Single Phase	Control Record	**RFT1**
RF	3-Phase	Data	**RF03**
RF	3-Phase	Control Record	**RFT3**

b) Load Survey as per clause 14.03 above.

c) Tamper Data:

Sr. No.	Tamper Event name as per Cl. No. 11.00	Occurance	Restoration
1)	Missing potential		
2)	Potential imbalance		
3)	Current unbalance		
4)	Current Reversal		
5)	Current circuit short		
6)	High Neutral Current (CT bypass)		
7)	Power ON / OFF		
8)	Magnetic Tamper		
9)	Meter cover Open with date & time	Only occurance	
Each latest tamper shall be displayed by meter on FIFO basis except tamper feature at sr. no. (9).			

15.11 BCS shall maintain the audit log for connection and disconnection of HHT to BCS. The BCS shall have the option of downloading audit log.

15.12 BCS shall maintain the downloaded meter data including energy parameters, billing history, tampers, TOD data and load profile data.

15.13 BCS shall store the data to database in encrypted format. Encryption used shall be provided free of cost to MSEDCL.

15.14 BCS shall generate following exceptional reports

(i) List of newly downloaded meters i.e. Meters not available in consumer master uploaded in HHT initially, but reading present in HHT.

(ii) List of Meters not downloaded i.e. Meter number available in consumer master uploaded in HHT, but reading not present in HHT.

15.15 Meter manufacturer shall provide API / Exe file with documentation for downloading the data from the meter along with the sample meter.

15.16 Checksum logic shall also be provided for the downloaded data along with the sample meter.

15.17 Checksum checking Exe / API shall also be given for validating downloaded meter data as well as generated XML file with sample meter.

15.18 It shall be possible to upload the HHT data to any PC having HHT software. A consumer based data uploading facility is required so that HHT shall upload data only in that PC which has the concerned consumers' data. The consumer number + meter number + make code shall be the key for creating consumers' files or overwriting consumers' files in PC.

15.19 The BCS software shall create one single file for the uploaded data, e.g. if HHT contains the meter readings of 2,000 consumer meters and the said data is uploaded to BCS, then the BCS shall create a single file containing separate records for each consumer meter reading. Also there shall be a provision to give filenames while creating the file.

15.20 Bidder has to provide any new additional reports from BCS software, if required by MSEDCL in future and the same shall be made available free of cost.

15.21 The meter manufacturer shall have to depute Hardware and Software Engineers on call basis who shall have thorough knowledge of meter hardware / software used for downloading and converting so as to discuss the problems, if any, or new development in the hardware / software with Chief General Manager (IT) / Chief Engineer, MM Cell, MSEDCL, Prakashgad, Bandra (E), Mumbai – 400 051 without any additional charge.

15.22 The meter sample with HHT shall be tested by our IT department for the protocol implemented and time required for downloading the data as confirmed by the bidder.

15.23 BCS shall support all current operating system versions and shall provide new version of BCS wherever the new version of operating system released.

15.24 As and when the meter manufacturer releases new or latest or advanced versions of meter hardware / firmware / software, the same shall be made available to purchaser immediately on the release date free of cost. The latest version shall support all existing hardware / meters in the field.

16.00 GPRS ENABLE HAND HELD TERMINAL (HHT)

16.01 HHT shall have in-built RF module and in-built GSM / GPRS Modem compatible with 3G, 4G. No separate / external attachment will be accepted.

16.02 RF module in HHT should support dual band operations- the ZigBee based 2.4GHz operation and 6LoWPAN based sub-1GHz operation.

16.03 HHT shall facilitate Manual band selection through keypad.

16.04 SIM slot of HHT shall have provision for sealing.

16.05 Modem in HHT shall be self-configurable.

16.06 In Built Modem should have following communication capabilities :

- Modem should be Dual Band modem capable of operating at 900 and 1800 MHz GSM transmission.
- Modem should support both Data and SMS transmission. It should have both GSM and GPRS/EDGE features.

16.07 RF HHT shall download meter data through RF port and the downloaded data shall be stored in HHT and transferred to MSEDCL MDAS (Head End system) through GPRS channel/USB.

16.08 Application in HHT shall be password protected and HHT should have common menu structure as given in Annexure-VII.

16.09 After power on the HHT, HHT program version should be displayed and by default it shall be in Meter Reading mode.

16.10 The HHT shall posses a specific Serial No. which cannot be changed. Every HHT shall be properly labeled with serial number / tender number / program name / program version.

16.11 HHT shall download the data of all the meters, irrespective of meter serial number present in HHT. It shall show listed (meter serial number available in HHT) and not listed meters whose data has been downloaded.

16.12 HHT shall show the following statistic of meters:

a. Total No. of Meters for reading in HHT.

b. Total No. of meter readings downloaded in HHT (excluding the new meters),

c. No. of new meters downloaded in HHT. (Meter Numbers not available in Job)

d. No. of Meters not downloaded in HHT.

16.13 HHT shall have the option to check the reading status (Downloaded or Not Downloaded) for any particular meter.

16.14 HHT shall not accept any external file other than BCS.

16.15 HHT Data files shall be deleted / removed from HHT as per value of job download status as given below :

i. Job Download Status = '0' and Clear HHT command is sent through BCS : Delete the .MRI files from HHT after confirmation from user.

ii. Job Download Status = '1' : No file in HHT should be deleted, even after receipt of clear HHT command from BCS.

iii. Job Download Status = '2' : While uploading new job from BCS to HHT, existing files in HHT shall be deleted. (BCS should issue clear HHT command before uploading new job to HHT).

iv. Refer job download status flag details in JOB.MRI file. (Annexure-VIII)

16.16 API which will be residing on HHT will be given to MSEDCL free of cost with all its documentation and training. Without API, meter samples shall not be approved.

16.17 The meter samples with HHT shall be tested by our IT Department for the time required for downloading the data as confirmed by the bidder.

16.18 While downloading billing data, by default every time HHT should download tamper present status for tampers as per protocol given in Annexure-IV & V. If tamper is found, then HHT should download tamper data of tampers present along with billing data.

16.19 Downloading time of only Billing data (as per clause No. 14.01) and tamper data, if tampers present, shall be less than 25secs(after joining the network). For single phase 6LoWPAN RF meters, downloading time of only Billing data and tamper data, if tampers present shall be less than 10 secs (after joining network).

16.20 The total time taken for downloading Billing, Tamper and Load Survey Data for 60 days of three phase 6LoWPAN RF meter shall be upto26 minutes(after joining network). For single phase 6LoWPAN RF meters, total time taken for downloading Billing, Tamper and Load survey data for 45 days shall be minimum 10 to 12 minutes (after joining network).

16.21 Commissioning and Deployment document is as per Annexure V.

16.22 Memory of HHT shall be minimum 256 MB.

16.23 The HHT shall be based on open ZigBee -2007 PRO with Smart energy profile protocol & 6LoWPAN for Interoperability with the settings given in clause 5.28 and Annexure IV & V of the specifications.

16.24 The bidder shall submit Zigbeecompliance certificate for radio modules used in the HHT. Likewise, the certificate of PICS (Protocol Implementation & Conformance Statement) in regards Manufacturer Specific Cluster from ZigBee Alliance Official Test House shall be submitted.

16.25 The HHT shall be supplied free of cost in the ratio of one for each 250 nos. meters supplied including user manual, AA size batteries and a set of direct communication cords for data downloading to the Laptop or PC for each HHT.

There shall be a provision for AUTO POWER SAVE, which shall force the instrument in the power saving mode in case of no-activity within 5 minutes. The data shall not be lost in the event the batteries are drained or removed from the HHT.

16.26 File structure to upload / export the meter details from BCS to HHT is as follows:

(e) Meter Serial Number – 8 chars.

(f) Meter Make Code – 3 chars.

(g) Consumer Number – 12 chars.

(h) Consumer Name – 50 chars.

(i) Consumer Address – 50 chars.

16.27 HHT shall be capable to download following data individually after respective command to HHT.

(a) Only Billing Data,

(b) Only Billing History,

(c) Only Tamper Data,

(d) Only TOD Data,

(e) Only Load Survey Data,

(f) All Data.

16.28 HHT shall be capable of downloading billing data of at least 2,000 (Two thousand) meters at a time. The HHT supplied shall be capable for downloading data of multiple designs and make of single phase & three

phase meters as well as for meters added in next 5 years for the common communication protocol attached herewith.

16.29 The meter specific MRI programs shall have the ability to use HHT real time clock to tag all time related events.

16.30 A real time clock shall be provided in the HHT. The clock shall have a minimum of 15 days battery backup with 30 year calendar. The time drift of the real time clock, considering all influencing quantities shall not exceed +/- 300 seconds per year.

16.31 After successful downloading of meter data to HHT, an indication on both, HHT and meter for confirmation of successful data transfer shall be provided for each set of data, viz. billing, load survey & tamper data. During this period, the energy recording in meter shall not be affected.

16.32 After downloading the data from meters, it shall be possible to create a single file for all records. The contents of this file shall not be editable.

16.33 Further, there shall be facility in HHT to provide the transfer of meter data to base computer through USB port only.

16.34 The interface for communication between HHT & Base computer shall be supplied free of cost. One chord of minimum length of 1 Mtr shall be provided with each HHT for downloading the data from HHT to base computer.

16.35 Necessary software conforming to the enclosed communication protocol, required for HHT and Base Computer System with necessary security provisions shall also be supplied free of cost.

16.36 The manufacturer / supplier shall modify the compatibility of HHT with the meter and the base computer system due to any change in language or any other reasons at their own cost within guarantee period.

16.37 The HHT shall have facility for re-entering the meter serial numbers directly from base computer system so that once these meters are read and the data is uploaded on base computer system, the serial numbers of existing meters could be deleted from the HHT and the meter serial numbers of other meters can be entered in the HHT.

16.38 While exporting the fresh (new) meter data from BCS to HHT, there shall have the option for downloading or deleting the existing (old) data present in HHT. Before deleting the data from HHT ask (prompt) (Yes/No) twice the user for confirmation to delete the data.

16.39 The HHT shall have battery low indication and automatic cut off to avoid further drain of the battery. The battery status should be indicated in the form of Bar-graph in the LCD display itself, clearly indicating the amount of charge available.

16.40 HHT should support endurance with fully charged battery for minimum 8 hours of operation.

16.41 Amendments to HHT application, if required, shall be provided free of cost and HHT shall be upgradable for all such software amendments.

16.42 The data stored in HHT shall be in common format as per Annexure-VIII.

16.43 The protocol for communication between HHT and BCS shall be common as per Annexure-IX. HHT should communicate with BCS software using protocol given in Annexure-IX only.

16.44 HHT should have degree of protection as per IP54.

16.45 The technical documents and manuals for GPRS enabled HHT shall be provided with all relevant details about HHT program and configuration required for HHT.

16.46 The HHT shall be type tested for (a) Tests of Mechanical requirement such as Free fall test, Shock Test, Vibration test, (b) Tests of Climatic influences such as Tests of Protection against Penetration of Dust and Water (IP 54), Dry Heat test, Cold Test, Damp Heat Cyclic Test, (c) Tests for Electromagnetic Compatibility (EMC), (d) Test of Immunity to Electromagnetic HF Fields and (e) Radio Interference Measurement.

16.47 The equipments offered shall be fully type tested at approved laboratory by National Accreditation Board for Testing and Calibration Laboratories (NABL) as per relevant standards within last 5 years from the date of opening of tender & the type test reports shall be enclosed with the offer.

17.00 COMMUNICATION PROTOCOL

As per Annexure –IV & V.

18.00 CONNECTION DIAGRAM AND TERMINAL MARKINGS

The connection diagram of the meter shall be clearly shown on inside portion of the terminal cover and shall be of permanent nature. Meter terminals shall also be marked and this marking shall appear in the above diagram. The diagram & terminal marking on sticker will not be allowed.

19.00 NAME PLATE AND MARKING

Meter shall have apurple colored name plate clearly visible, effectively secured against removal and indelibly and distinctly marked with all essential particulars as per relevant standards. Meter Serial Number shall be Bar Coded along with numeric number. The size of bar coded number shall not be less than 35x7 mm. The manufacturer's meter constant shall be marked on the name plate. Meter serial number & bar code on sticker will not be allowed. In addition to the requirement as per IS, following shall be marked on the name plate.

a) Purchase order No & date

b) Month and Year of manufacture

c) Name of purchaser, i.e. MSEDCL

d) Guarantee Five Years

e) ISI mark

f) Communication capability: 6LoWPAN LPRF. The character height of the same shall be minimum 3 mm in capital letters.

g) A sticker label containing warning notice in Marathi language which is to be stick up on meters front cover or printed on meter name plate with easily readable font size not less than 10 in red colour, which reads as

"सावधान ! मीटरला फेरफार करण्याचा प्रयत्न केल्यास अधिकतम वेगाने वीज नोंदणी होणार"

20.00 TESTS:

20.01 TYPE TESTS:

Meter shall be fully type tested as per IS: 13779 / 1999 (amended up to date) and external AC (except 0.2 T AC magnet) / DC magnetic influence tests as per CBIP Tech-Report 88 with latest amendments. The Type Test Reports shall clearly indicate the constructional features of the type tested meters. Separate Type Test Reports for each offered type of meters shall be submitted. Type test reports for HHT as stated in the clause No. 16.46 shall be submitted before commencement of supply. All the Type Tests shall have been carried out from Laboratories which are third party accredited by the National Board of Testing and Calibration Laboratories (NABL) of Govt. of India such as CPRI, Bangalore / Bhopal, ERDA Vadodara, to prove that the meters meet the requirements of the specification.

Type Test Reports conducted in manufacturers own laboratory and certified by testing institute shall not be acceptable.

Type test reports shall be submitted along with offer. The purchaser reserves the right to demand repetition of some or all the type tests in presence of purchaser's representative at purchaser's cost.

Additional acceptance test except transportation test shall be submitted before commencement of supply and shall be get approved by C.E.(MMC).

20.02 The meter shall pass all the 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 to 8 meters from a lot more than 1,000 will be sealed randomly in the factory and will be tested for tamper events).

20.03 **ADDITIONAL ACCEPTANCE TESTS:**

The following additional tests shall be carried out in addition to the acceptance tests specified in IS: 13779/1999 (amended up to date)

(a) **Transportation Test:**

At least 50% of the samples of the meter be tested for error at Imax, Ib and 5% Ib at unity power factor and 50% Imax and 10% Ib at 0.5 lagging Power Factor besides checking them for starting current. This test shall be conducted on ready to install meter i.e. meter cover ultrasonically welded & sealed. After recording these errors, the meter be put in their normal packing and transported for at least 50 km in any transport vehicle such as pick up van, Jeep, etc. on uneven rural roads and then re-tested at all these loads after the transportation. The variation in errors recorded before and after transportation shall not exceed 1% at higher loads and 1.5% at loads below Ib.

(b) **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. Meter shall be tested for tamper conditions as stated in this specification.

iii. Glow wire testing for poly-carbonate body.

iv. Power consumption tests shall be carried out.

v. Verification of data transfer / downloading via RF port as per technical specifications,The data verification will be carried out at communication testing lab of IT Section of MSEDCL at corporate office. During the testing in communication testing laboratory, protocol implemented in the meter will be verified.shall be allowed. If meter protocol is as per Clause No. 17 then further testing will be carried out. Draft testing parameters are given in Annexure-X.Being the first tender for 3 phase 6LowPAN RF Meter, firmware and software up gradation of sample meters without opening meter cover, is allowed during evaluation, if required.

vi. The meter shall comply all the tests for external AC / DC magnetic field as per CBIP Tech Report 88 with latest amendments. Moreover, the magnetic influence test for permanent magnet of 0.5 T for minimum period of 15 minutes shall be carried out by putting the magnet on the meter body. If, during the test, the accuracy of the

meter gets affected, then the same shall be recorded as magnetic tamper event with date & time stamping and the meter shall record energy considering Imax and reference voltage at unity power factor in all the three phases. After removal of magnet, meter shall be subjected to accuracy test as per IS: 13779 /1999 (amended up to date). No deviation in error is allowed in the class index as per IS: 13779 /1999 (amended up to date) & this specification.

vii. The meter shall withstand impulse voltage at 10 kV.

viii. The meter shall remain immune for the test of electromagnetic HF/RF defined under the test no. 4.0 for EMI/EMC of IS 13779:1999 amended up to date. The meter shall remain immune for any higher signals than the present standards and MSEDCL technical specifications as indicated above.

Jammer test for sample meters shall be carried out for immunity at MSEDCL's Testing Division

The test 20.03 (b) (i) to (v) shall be carried out at factory for each inspected lot at the time of pre dispatch inspection.

The tests 20.03 b) (vi), (vii) & (viii) shall be carried out on one sample from first lot as per procedure laid down in IS: 13779 / 1999 (amended up to date) and CBIP Tech Report 88 (with latest amendments) in NABL LAB. The test report shall be got approved from Chief Engineer, MSEDCL, Material Management Cell, (MSC) 1st Floor, Prakashgad, Bandra (East), Mumbai – 400 051 before commencement of supply

Jammer test for sample meters shall be carried out at MSEDCL's Testing Division

(c) **Limits of error:**

(i) Limits of variation in percentage error due to change in voltage shall not exceed the values given in the following table:

Sr. No.	Influence quantities	Value of current (Balanced, unless otherwise stated	Power factor	Limits of variation in % error for class 1 meter

(a)	Voltage variation between – 15% to +10%	Ib	1 0.5 lag	0.7 1.0
(b)	Voltage variation between – 40%, + 20% and + 10%	Ib	1 0.5 lag	1.1 1.5

(ii) The meter shall be tested at (-) 15% and at (-) 40% of reference voltage as well as (+) 10% and (+) 20% of reference voltage and shall record energy within limits of variation indicated above.

(iii) For other influence quantities like frequency variation, voltage unbalance etc. the limits of variation in percentage error will be as per IS: 13779 / 1999. (Amended up to date).

21.00 GUARANTEED TECHNICAL PARTICULARS:

The tenderer shall also furnish the particulars giving specific required details of Meters in schedule `A' attached. The offers without the details in Schedule `A' stand rejected.

22.00 PRE DESPATCH INSPECTIONS:

All Acceptance tests and inspection shall be carried out at the place of manufacturer unless otherwise specially agreed upon by the manufacturer and purchaser at the time of purchase. The manufacturer shall offer to the inspector representing the purchaser, all the reasonable facilities, free of charge, for inspection and testing, to satisfy him that the material is being supplied in accordance with this specification.

The MSEDCL's representative / Engineer attending the above testing will carry out testing on suitable number of meter as per sampling procedure laid down in IS 13779/1999 (amended up to date) and additional acceptance test as per this specification and issue test certificate approval to the manufacturer and give clearance for dispatch. The meter shall be sealed after inspection at works.

The first lot of meter may be jointly inspected by the Executive Engineer, Testing Division and the Executive Engineer, (Inspection Wing).

23.00 JOINT INSPECTION AFTER RECEIPT AT STORES (Random Sample Testing):

For carrying out Random Sample Testing (RST), the sample meters & CMRI shall be drawn from any one of the stores against inspected lot and same shall be tested at any of the Testing and Quality Assurance Units at

Aurangabad, Bhandup, Kolhapur, Nagpur, Nashik and Pune.

Sample meters shall be drawn as per Annex H (Recommended Sampling Plan) of IS: 13779 / 1999 (amended upto date).

Sample meters shall be tested by MSEDCL Testing Engineer in presence of supplier's representative jointly for (i) Starting Current, (ii) Limits of error, (iii) Repeatability of error, (iv) No Load Test as per IS: 13779 / 1999 (amended upto date), (v) tamper conditions as per technical specifications and (vi) data downloading time as per specifications.

The 5 days advanced intimation shall be given to the supplier and if the supplier fails to attend the joint inspection on the date informed, the testing shall be carried out by our Testing Engineer in absence of supplier's representative. If the meters failed in above Random Sample Testing, the lot shall be rejected.

24.00 GUARANTEE:

The meter and CMRI shall be guaranteed for the period of five years from the date of commissioning or five and half year from the date of dispatch whichever is earlier. The equipments found defective within above guarantee period shall he replaced / repaired by the supplier free of cost, within one month of receipt of intimation. If defective equipments are not replaced / repaired within the specified period as above, the MSEDCL shall recover an equivalent amount plus 15% supervision charges from any of the bills of the supplier.

25.00 PACKING:

25.01 The meters & CMRIs shall be suitably packed in order to avoid damage or disturbance during transit or handling. Each meter & CMRI may be suitably packed in the first instance to prevent ingress of moisture and dust and then placed in a cushioned carton of a suitable material to prevent damage due to shocks during transit. The lid of the carton may be suitably sealed. A suitable number of sealed cartons may be packed in a case of adequate strength with extra cushioning, if considered necessary. The cases may then be properly sealed against accidental opening in transit. The packing cases may be marked to indicate the fragile nature of the contents.

25.02 The following information shall be furnished with the consignment:

- Name of the consignee
- Details of consignment
- Destination
- Total weight of the consignment

- Sign showing upper / lower side of the crate
- Sign showing fragility of the material
- Handling and unpacking instructions
- Bill of Materials indicating contents of each package & spare material

26.00 TENDER SAMPLE

Tenderer are required to submit 15 (Fifteen) nos. of sample meters and 1 (one) HHT along with the API software, protocol & documentation of offered type as per technical specifications on or before the time & date stipulated for submission of offer for testing the sample meters in third party NABL Lab like ERDA, CPRI, CIPET, ERTL, etc. and offered API / protocol with BCS by our IT Department as per technical specifications.

The offer of those eligible bidders shall only be considered if the sample passes the tests at NABL Lab as well as necessary certification from our IT Department for the offered API / protocol. The results of NABL Lab and the certification from IT Department for offered API / protocol shall not be disputed and shall be binding on the bidder. The required information such as Manufacturer's Name or Trade Name, Sr. No., ISI Certification No., API specification No. etc. shall be provided on inner/outer portion of sample meters being submitted along with the offer.

Out of these, two samples shall be without Ultrasonic welding to confirm constructional features.

27.00 QUALITY CONTROL

The purchaser has a right to send a team of experienced engineers for assessing the capability of the firm for manufacturing and testing of meter as per this specification.

The team shall be given all assistance and cooperation for inspection and testing at the bidder's work.

28.00 MANUFACTURING ACTIVITIES

28.01 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.

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.

28.02 The manufacturer shall submit the list of plant and machinery along with the offer.

28.03 Meter shall be manufactured using SMT (Surface Mount Technology) components and by deploying automatic SMT pick and place machine and reflow solder process.

Further, the Bidder shall own or have assured access (through hire, lease or sub-contract, documentary proof shall be attached with the offer) of above facilities.

28.04 The calibration of meter shall be done in-house.

28.05 Quality shall be ensured at the following stages.

28.05.01 At PCB manufacturing stage, each Board shall be subjected to computerized bare board testing.

28.05.02 At insertion stage, all components shall under go computerized testing for conforming to design parameter and orientation.

28.05.03 Complete assembled and soldered PCB shall under go functional testing using Automatic Test Equipments (ATEs).

28.05.04 Prior to final testing and calibration, all meter shall be subjected to ageing test (i.e. Meter will be kept in ovens for 72 hours at 55 deg C temperature & at full load current. After 72 hours meter shall work satisfactory) to eliminate infant mortality.

28.06 The bidders shall submit the list of all imported and indigenous components separately used in meter along with the offer.

28.07 Bought out items:

A detailed list of bought out items which are used in the manufacturing of the meter shall 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.

28.08 List of Plant and Machinery used for production of energy meter:

SN	List of Plant and Machinery used for Energy meter Production	
1	Fully automatic testing Bench with ICT for testing link less meter	Routine Testing and Calibration of Meter
2	Semi automatic testing Bench with MSVT	Routine Testing and Calibration of Meter
3	IR Tester	Insulation testing
4	HV Tester	Insulation testing
5	Error calculators	Error testing
6	Long duration Running test set ups	Reliability Testing
7	Reference Meter Class 0.1 accuracy	Error calculation
8	Ultrasonic welding Machines	Welding of meter
9	Automatic Pick and Place Machines	Automatic placing of SMT components
10	Solder Paste Printing Machine	SMT soldering
11	Soldering Furnace IR reflow	SMT soldering
12	PCB Scanner	For testing of PCBs
13	ATE functional tester	For testing of Components
14	Programmers and Program Loaders	Chip Programming Tools
15	CAD PCB designing setups	PCB designing
16	Furnace IR type for Hybrid Micro Circuits	Resistance network and HMC manufacturing
17	Laser Trimming Machines	Trimming of resistances for higher accuracy measurement

18	Wave Soldering Machines	Wave soldering of PCBs
19	Humidity Chamber	Accelerated testing for Life cycle
20	Dry Heat Test Chamber	Accelerated testing for Life cycle
21	Thermal Shock Chamber	Accelerated testing for Life cycle
22	PRO - E Mechanical Design Stations	Mechanical CAD stations
23	Spark Erosion Tool fabricating Machine	Tool fabrication and Die manufacturing
24	CNC wire Cut Tool Fabrication machine	Tool fabrication and Die manufacturing
25	CNC Milling Machine for composite tool fabrication	Tool fabrication and Die manufacturing
26	Injection Moulding Machine	Moulding of plastic parts
27	Vibration testing Machine	Vibration testing of Meter
28	Glow Wire Test machine	Testing of Plastic Material
29	Fast transient burst testing setup	Type testing of Meter
30	Short term over Current testing setup	Type testing of Meter
31	Magnetic and other tamper testing setups	Tamper Testing
32	Impulse Voltage Testing Setup	Type testing of Meter
33	Composite Environmental testing chambers	Type testing of Meter

29.00 QUALITY ASSURANCE PLAN:

29.01 The tenderer shall invariably furnish QAP as specified in Annexure - I

along with his offer the QAP adopted by him in the process of manufacturing.

29.02 Precautions taken for ensuring uses of quality raw material and subcomponents shall be stated in QAP.

30.00 COMPONENT SPECIFICATION:

As per Annexure - II enclosed.

31.00 SCHEDULES:

The tenderer shall fill in the following schedules, which are part and partial of the tender specification and offer. If the schedules are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule 'A' .... Guaranteed technical particulars. (As per GTP uploaded on e - tendering site)

Schedule 'C' .... Tenderer Experience

The discrepancies if any between the specification and the catalogs and / or literatures submitted as part of the offer by the bidders, the same shall not be considered and representations in this regard shall not be entertained.

SCHEDULE 'C'

TENDERER'S EXPERIENCE

Tenderer shall furnish here a list of similar orders executed / under execution for supply of three phase static energy meter by him to whom a reference may be made by purchaser in case he consider such a reference necessary.

Sr. No.	Name of client	Order No. & Date	Qty. Ordered	Qty. Supplied

NAME OF FIRM _____

NAME & SIGNATURE OF TENDERER _____

DESIGNATION _____

DATE _____

ANNEXURE - I

Quality Assurance Plan

A) The bidder shall invariably furnish the following information along with his bid, failing which his bid shall be liable for rejection. Information shall be separately given for individual type of material offered.

(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 test normally carried out on raw materials in presence of Bidder's representative, copies of test certificates:

(ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.

(iii) List of manufacturing facilities available.

(iv) Level of automation achieved and list of areas where manual processing exists.

(v) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

(vi) List of testing equipment available with the bidder for final testing of equipment specified and test plan limitation. If any, vis-a-vis the type, special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly bought out in schedule of deviation from specified test requirements.

B) The successful bidder shall within 30 days of placement of order, submit following information to the purchaser.

(i) List of raw materials as well as bought out accessories and the names of sub-suppliers selected from those furnished along with offers.

(ii) Type test certificates of the raw materials and bought out accessories if required by the purchaser.

(iii) Quality assurance plan (QAP) with hold points for purchaser’s inspection.

The quality assurance plant and purchasers hold points shall be discussed between the purchaser and bidder before the QAP is finalized.

C) The contractor shall operate systems which implement the following:

(i) Hold point: A stage in the material procurement or workmanship process beyond which work shall not proceed without the documental approval of designated individuals organizations. The purchaser’s written approval is required to authorise work to progress beyond the hold points indicated in quality assurance plans.

(ii) Notification point: A stage in the material procurement or workmanship process for which advance notice of the activity is required to facilitate witness. If the purchaser does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice then work may proceed.

D) The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing if required by the purchaser and ensure that Quality Assurance program of the contractor shall consist of the quality systems and quality plans with the following details.

(i) The structure of the organization.

The duties and responsibilities assigned to staff ensuring quality of work.

The system for purchasing, taking delivery and verification of material.

The system for ensuring quality workmanship.

The system for retention of records.

The arrangement by contractor for internal auditing.

A list of administration and work procedures required to achieve and verify contract's quality requirements shall be made readily available to the project manager for inspection on request.

(ii) Quality Plans:

An outline of the proposed work and programme sequence.

The structure of the contractor's organization for the contract.

The duties and responsibilities assigned to staff ensuring quality of work.

Hold and notification points.

Submission of engineering documents required by the specification.

The inspection of materials and components on receipt.

Reference to the contractor's work procedures appropriate to each activity.

Inspection during fabrication / construction.

Final inspection and test.

ANNEXURE – II

COMPONENT SPECIFICATION

SN	Component Function	Requirement	Makes & Origin
1.	Current Transformers	The Meters shall be with the current transformers as measuring elements. The current transformer shall withstand for the clauses under 5 & 9 of IS: 13779 / 1999	
2.	Measurement or computing chips	The measurement or computing chips used in the Meter shall be with the Surface mount type along with the ASICs.	USA: Teridian, Analog Devices, Cyrus Logic, Atmel, Philips, Dallas, ST, Motorola, Texas Instruments, Maxim, Freescale, National Semiconductor, Onsemiconductors. Germany: Siemens. South Africa: SAMES. Japan: NEC, Toshiba, Renasas, Hitachi. Austria: AMS. Holland: Philips (N X P) Taiwan: Prolific
3.	Memory chips	Memory chips shall not be affected by external parameters like sparking, high voltage spikes or electrostatic discharges. Meter shall have nonvolatile memory (NVM). No other type of memory shall be used for data recording and programming. (The life of the NVM is highest). There shall be security isolation between metering circuit, communication circuit, and power circuit.	USA: Teridian, Atmel, Philips, ST, National Semiconductors, Texas Instruments, Microchip, Spason (Fujitsu), Ramtron. Japan: Hitachi, Renasas. Germany: Siemens

4.	Display modules	a) The display modules shall be well protected from the external UV radiations. b) The display visibility shall be sufficient to read the Meter mounted at a height of 0.5 meter as well as at the height of 2 meters (refer 3.2 d for viewing angle). c) The construction of the modules shall be such that the displayed quantity shall not disturb with the life of display (PIN Type). d) It shall be Tran-reflective HTN or STN type industrial grade with extended temperature range.	Singapore: Bonafied Technologies, Displaytech, E-smart Korea: Advantek, Jebon, Union Display Inc. Hong Kong: Genda China: Success, Truly,Tianma Japan: Hitachi, Sony, L & G. Malaysia: Crystal Clear Technology.
5.	Communication Modules	Communication modules shall be compatible for the two ports (one for optical port for communication with meter reading instruments & the other for the hardwired RS-232 port to communicate with various modems for AMR)	USA: Agilent, HP, Fairchild, National Semiconductors, Optonica. Holland: Philips. Korea: Phillips. Japan: Hitachi. Taiwan: Ligitek
6.	Optical port	Optical port shall be used to transfer the meter data to meter reading instrument. The mechanical construction of the port shall be such to facilitate the data transfer easily.	USA: HP, National Semiconductors, Maxim. Holland: Philips. Korea: Phillips. Japan: Hitachi Taiwan: Ligitek, Everlight Germany: Osram
7.	Power supply	The power supply shall be with the Capabilities as per the relevant standards. The power supply unit of the meter shall not be affected in case the maximum voltage of the	SMPS Type

		system appears to the terminals due to faults or due to wrong connections. It shall not also be affected by magnet	
8.	Electronic Components	The active & passive components shall be of the surface mount type & are to be handled & soldered by the state of art assembly processes.	USA: Atmel, National Semiconductors, BC Component, Philips, Texas Instruments, Analog Devices. ST, Onsemiconductors, Maxim, Muruta, Kemet, Freescale, AVX, Intersil, Raltron, Fox, Fairchild, Agilent, Abracon, Diode Inc., Honeywell, Sipex Power Integration, R-ohm. Japan: Hitachi, Oki, AVZ, Ricon, Toshiba, Epson, Kemet, Alps, Muruta, TDK, Sanyo, Samsung. India: RMC, VEPL, KELTRON, Incap, PEC, Cermet, Gujarat Polyavx, Prismatic, MFR Electronic Components Pvt. Ltd., CTR. Korea: Samsung Japan: Panasonic Germany: Kemet, Vishay, Epcos, Diotech, Infineon. Taiwan: Yageo
9.	Mechanical parts	a) The internal electrical components shall be of electrolytic copper & shall be protected from corrosion, rust etc. b) The other mechanical components shall be protected	

		from rust, corrosion etc. by suitable plating / painting methods.	
10.	Battery	Maintenance free battery (Ni-mh or Li-ion) of long life of 10 years. Only non-rechargeable battery shall be used for RTC as well as display in absence of Power since the life & Reliability of these are better than the rechargeable batteries.	USA: Varta, Tedirun, Sanyo or National, Maxell, Renata. Japan: Panasonic, Sony, Mitsubishi. France: Saft. Korea: Tekcell. Germany: Varta.
11.	RTC & Micro controller.	The accuracy of RTC shall be as per relevant IEC / IS standards.	USA: ST, Teridian, Philips, Dallas, Atmel, Motorola, Microchip. Japan: NEC, Oki, Epson.
12.	P.C.B.	Glass Epoxy, fire resistance grade FR4, with minimum thickness 1.6 mm.	

ANNEXURE - III

MAKE CODE OF METERS

Make Code	Description
002	ANDHRA PRADESH ELECTRIC EQUIPMENT COR. LTD.
003	A.E.G.
004	BARODA ELECTRIC METERS LTD., VALLABH VIDYANAGAR
006	CHAMBERLAIN & HOOKHAM LTD.
008	DASS HITACHI PVT. LTD., NEW DELHI
010	ELECTRIC CONSTRUCTION & EQUIPMENT CO., SONEPAT
014	ELECTRICAL INSTRUMENTS MFG.CO.LTD. AHMEDABAD
015	HAVELLS ELECTRICALS
016	INDIA METERS LIMITED, MADRAS
018	INDUSTRIAL METERS PRIVATE LIMITED
020	JAIPUR METERS & ELECTRICALS LIMITED, JAIPUR
022	LANDIES & GYR LIMITED
023	LINKWELL TELESYSTEMS, HYDERABAD
024	MALIK METERS PRIVATE LIMITED, BOMBAY
026	METERS & INSTRUMENTS PVT. LTD., NEW DELHI
028	RADIO & ELECTRICALS MFG.CO.LTD., BANGALORE
030	SIMCO METERS LIMITED, TIRUCHIRAPALLI
034	UNITED ELECTRICAL INDUSTRIES LTD.,CALCUTTA
035	VOLTAS
036	AEC COMPANY
038	ARON
039	ALLIED ENGGINEERING WORKS LTD.

040	BUXLELS
041	DELHI CONTROL DEVICES PVT. LTD.
042	C.R.E. WOD CO. PVT. LTD.
043	GENUS INNOVATION LTD.
044	CONTIMENTS
045	NAINA POWER PVT. LTD.
046	GANG & CO. LTD., BUDAPEST
048	KRIZIC
050	SIEMENS
052	SCLUMBER
053	L & T
054	Datapro
055	Secure
056	DUKE ARNIES
057	A.B.B
058	ROLEX
059	L&G
061	ELYMER
062	AVENER
063	ELSTER METERING
064	ACCURATE
065	GENUS
066	CAPITAL POWER SYSTEMS PVT LTD
067	VAN ELECTRO DEVICES PVT LTD

068	GEC ALSTHOM INDIA LTD
069	GILBERT ELECTRICALS AND ELECTRONICS PVT LTD
070	KEI ELECTRICALS PVT LTD
071	MODEN INSTUMENTS PVT LTD
072	POWERTEC METERS
074	EMCO
075	HIMACHAL ENERGY
076	HPL
078	SHENZEN
079	SEMICONDUCTOR COMPLEX LTD
080	LOTUS WIRES AND CABLES
081	OMNI AGATE SYSTEM
082	PALMOHAN
083	SYNERGY
084	RC ENERGY METERING PVT. LTD
086	MOTWANI MANUFACTURE
087	MODERN INSTRUMENTS PVT LTD
088	AVON METERS
089	KELTRON COUNTERS LTD
091	TERANA INFOTECK
092	NATIONAL TELECOM
093	TTL LTD
094	TOWERS AND TRANSFORMERS
095	ESPRITE SWITCHGEAR PVT LTD

096	BENTEX ELECTRICALS
097	BHARAT HEAVY ELECTRICAL LTD
098	FLASH

ANNEXURE IV

MSEDCL 6LOWPAN PROTOCOL

Introduction

MSEDCL has previously deployed LPRF meters based on ZigBee Smart Energy 1.0 profile operating in 2.4GHz – 2.485GHz, with an MSEDCL specific profile used for data collection. These meters were primarily deployed in Urban areas of Mumbai, Pune and Nashik zones.

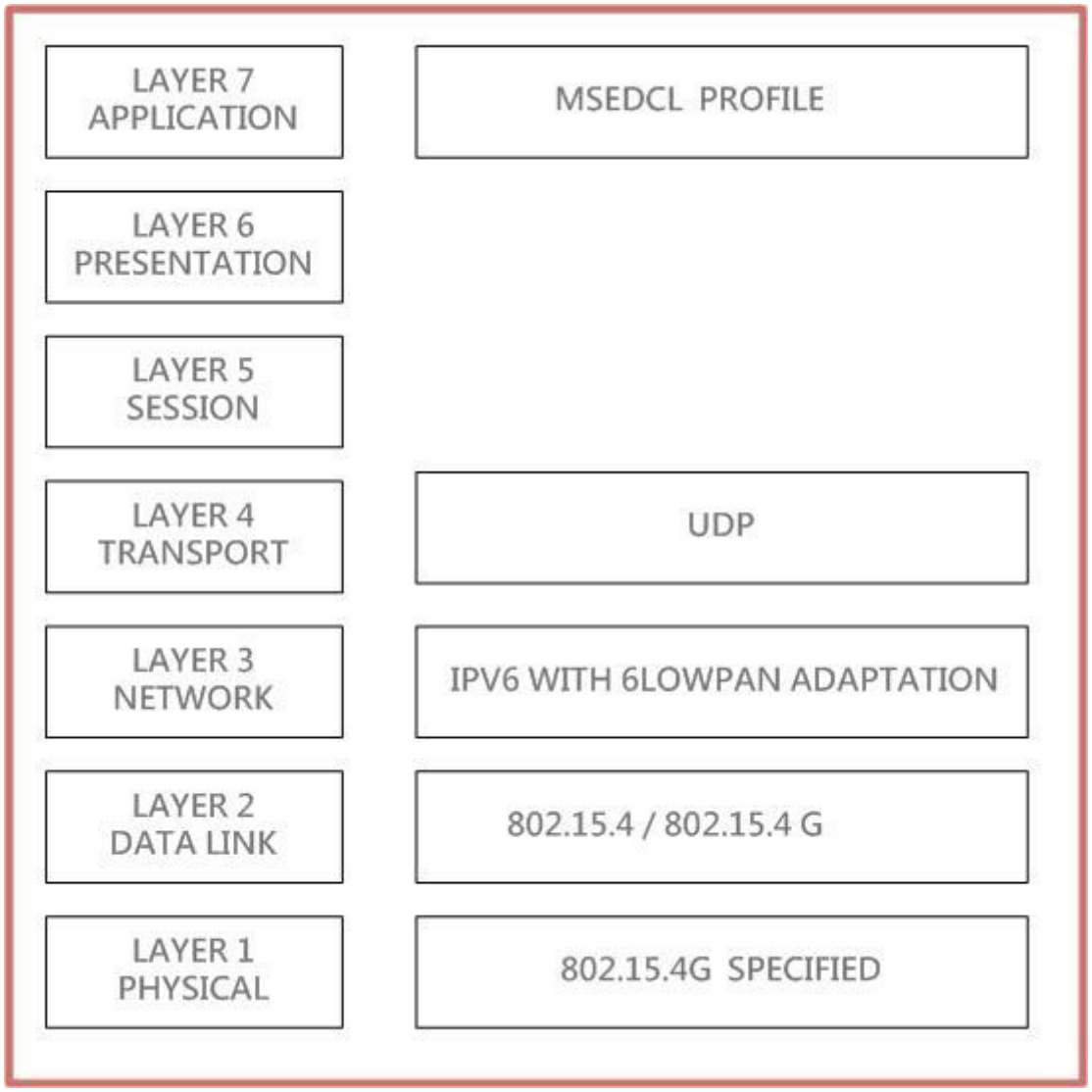
Going forward, LPRF meters are sought to be deployed in rural, Rurban and Urban areas.

The new meters shall support LPRF data downloading based on 6lowpan networking on sub 1 GHz. The principal driver is the enhanced range that is expected out of a sub 1GHz implementation. At the same time, some of the learning from previous deployments is factored in. This document specifies the complete data downloading protocol(s) that need to be implemented; where relevant, references are made to standard documents – RFCs and IEEE standards; where appropriate, desired protocols are fully defined in the documents.

NOTE : ALL Hand Held Units shall support dual band operations – the ZigBee based 2.4GHz operation and 6lowpan based sub 1GHz operation. HHU shall facilitate Manual band selection through keypad

Protocol Overview

The protocol stack layers are as given below:



Each of the layers is explained in separate sections in the document.

APPLICATION LAYER

This protocol is the same protocol as used in the ZigBee implementation of LPRF metering previously at MSEDCL. The protocol is implemented as a series of attribute IDs as included in the Annexure-VI of this document.

TRANSPORT LAYER

All metering devices shall implement UDP protocol as defined in relevant RFC's. Meter data shall be available for reading on UDP port 61616. The meter shall implement an UDP server on this port to respond to data acquisition commands from HHU / DCU. Port no 61616 for meter data downloads and critical

parameter communication. However, 61618 will be used for network parameters setting and commissioning as specified.

However, other than root assignment, commissioning is not usually required. The root assignment process is illustrated in the section no. 5.2

NETWORK LAYER

IPv6

IPv6 has to be implemented in the meters as detailed in RFC2460 and derivative/companion documents. The network proposed to be implemented will be an isolated 6lowpan network.

ICMPv6

Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification, as defined in RFC4443 needs to be implemented. The devices must support ICMPv6 Error messages, Echo Reply and Echo Request messages.

Addressing

IPv6 addresses are 16x8 bit addresses. In the proposed network, this must be constructed out of a combination of 8 byte IPv6 prefix for the most significant 8 byte and the 8 byte MAC address of the node. The IPv6 address should be constructed based on RFC4862, with the following considerations:

8 byte IPv6 prefix, shall be assigned two different address for both Local & Global Address. “FE 80 00 00 00 00 00 00“ will used for Local Addresses and the prefix for global addresses shall be allotted later.

All UDP communication has to be based on Global IPv6 address. The Initial handshaking (DIS/DIO /DAO) will use the local link address.

8 byte MAC address, this will consist of:

5 most significant bytes containing organizationally unique identifier (OUI) purchased from IEEE

The last three significant bytes shall be mapped to the serial number of the energy meter.

MESH AND ROUTING

RPL protocol is used for routing of data. This protocol is specified in RFC 6550 and its companion RFCs 6551 – 6554 and RFC 6719. MRHOF will be used. Transit information including parent option will be included in the DAO messages. Hop by hop option is mandatory in all UDP packets.

ADAPTATION LAYER

The Adaptation layer is 6lowpan. This is an adaptation of IPv6 packets onto the underlying Lossy Low power Network (LLN). The RFCs / standards are written keeping IEEE 802.15.4g MAC standards, expecting 128 octet packet sizes over the air. The relevant RFCs are 4944, 6282.

MAC LAYER

The MAC layer is a derivative of IEEE 802.15.4G specification in terms of MAC Layer headers and usage of IEEE headers. The packet & protocol options, protocol specified commands will be as follows.

MAC layer under 6lowpan is essentially a link layer broadcast protocol. While the 802.15.4G defines multiple packet types, the MAC_DATA_PACKET type suffices for the 6lowpan packet exchange. Further, nodes must respond with BEACON packets in response to BEACON_REQUEST messages. Link layer acknowledgements should be disabled.

NOTE: All MAC packets will be preceded by a 4-byte preamble (0x55, 0x55, 0x55, 0x55), followed by a 2-byte Sync word (0x90, 0x4E) followed by 2-byte frame control (Phy A &Phy B bytes in 802.15.4G). Nodes are required to transmit using 2 byte CRC.

4-byte preamble	2-byte sync word	2 byte Phy frame control	MAC Protocol data unit

MAC DATA PACKET

This MAC packet type is used for all 6lowpan communication messages. The packet will have the following structure(s) for different 6lowpan use cases.

Point to point application data communication

2byte Frame control	1 byte sequence number	2 byte destination PAN	8 byte Destination MAC address	8 byte Source MAC address	Security Header	Payload Data	2 byte FCS

Local broadcast as used in a DIO message (for example)

MHR to be coded as follows :

2byte Frame control	1 byte sequence number	2 byte destination PAN	2 byte Destination address (0xFFFF)	8 byte Source MAC address	Security Header	Payload Data	2 byte FCS

MAC packet format for Beacon Request

Frame control (2bytes)	Sequence number (1byte)	Destination PAN (2bytes)	Destination Address (2bytes)	Command identifier (0x07) (1 byte)	FCS (2 bytes)

MAC packet format for Beacon Messages

Frame control (2 bytes)	Sequence number (1 byte)	Source PANID (2 bytes)	Source Address (8 bytes)	Superframe specification (2 bytes)	GTS field (1byte)	Pending Addresses Fields (1 byte)	FCS (2 bytes)

Super Frame Specification: 0xCFFF

GTS Fields: 0x00

Pending Addresses Fields: 0x00

All the above fields should be ignored in MAC header processing by receiving nodes.

PHY LAYER

The Phy layer specifications are derived from 802.15.4g specification and it is mandatory to use IEEE802.15.4g phy mode #1. The standard is not applicable to Indian context & constraints (as per WPC specifications).

Therefore, suitable adaptation has been made here and should be implemented as follows:

Frequency Band: 865-867 Mhz

Channel Spacing: 200 KHz

Number of Channels: 9

Channel Centre Frequencies (MHz): ChanCenterFreq = ChanCenterFreq 0 + NumChan · ChanSpacing

Where, ChanCenterFreq 0 = 865.125 MHz

Data rate: 50 kbps

Modulation: Filtered 2FSK (2GFSK)

Modulation Index: 1.0

Preamble: 0x55555555

Sync word: 0x904E

Default Channel Center Frequency: 865.525 MHz (Channel #2)

Frequency Deviation: 25 kHz

SECURITY

All the data transmission in network must be encrypted. This implementation will use AES-CCM-32 encryption using 128 bit security key (Key will be provided by MSEDCL). AES key should be programmable over the air (protocol as defined in section 6).

Implicit key shall be used and Encryption & decryption keys will same.

FACTORY DEFAULT NETWORK PARAMETERS

Frequency / Channel: 0x02

Device type: Router

Device State: Not joined

PAN: 0xFFFF

Default Encryption Key :0x000000000000000000004D534544434C

Prefix: 0xFFFF000000000000 (0xFFFF::)

MAC address: As defined in section 2.3.3

Theory of Operation – network formation and commissioning

Description:

On power on, if the router is in a commissioned state, shall issue the DIS message (Reference: RFC6550) once every minute, with a 20% random jitter. Network joins happen on the basis of DIO, DAO and ICMP echo-request and ICMP echo-reply messages. The network shall be a storing mode network, with each node capable of hosting routes of 200 children. The timing of transmission of DIO messages shall follow trickle algorithm specification as specified under RFC 6206.

Subsequent to a network join, a node shall transmit DIO messages at 4s, 8s, 16s, 32s, 64s, 128s, 256s, 512s and 1024s with a 10% random jitter. Subsequent to this, DIO messages shall be transmitted every 1024s with random jitter, till a global repair command is received at which time the trickle timer shall be reset.

If the device is not in a commissioned state, it should be a router in factory default network parameters. In this state, it shall be issuing a IEEE 802.15.4G MAC BEACON REQUEST packet, once every 1 minute with a 20% random jitter.

On the basis of MAC BEACON packets received, the device then makes a list of available PANs, and initiates the 6lowpan network join procedure in each of those PANs. When a meter tries to join different PAN IDs, the maximum time needed to wait in DIS state is 3 DIS periods. There is no MAC join procedure.

6lowpan network join procedure is the standard 6lowpan RPL join process as defined in RFC6550. A minute after the DAO, the new node shall send a ping-request to the root node; if the node does not receive a ping-reply within 10 attempts of ping requests, each issued a minute (with random jitter) apart, the new node shall detach itself from the parent and restart the join procedure on the next discovered PAN.

Once a ping response from the root is received, the router device saves the network parameters for future and marks itself as commissioned. No DIO messages shall be transmitted by this node prior to this state.

Specifying a root node.

All the devices in the network should be capable of being 6lowpan root devices, though factory defaults set them to be routers. One of the (centrally located) nodes shall be identified and configured as a ROOT by HHT/DCU. ROOT assignment involves setting the target Short PAN, channel, device type, IPv6 Prefix, AES key. Information to be further given will include the list of devices to be allowed into the network. The ROOT shall respond to ping requests to those devices that are in this list.

Hand Held Terminal (HHT) should join the network as ROOT while commissioning of meters. Though HHT act as ROOT, reply to ping-requests should not be given by HHT

COMMISSIONING PROTOCOL

UDP payload with 61616

1-byte Frame Type	1 - byte Sequence no	1 - byte Command ID	1 - byte Attribute count	1 - byte Attribute ID	Attribute ID value [Optional]

Frame Type Details

Frame Type	**Description**
0x00	Read / Write commission request
0x01	Restart command request
0x02	Read / Write commission response
0x03	Restart command response
0x04 to 0xFF	Reserved

Command Identifier details

Command Identifier	**Description**
0x00	Commission Write command Request
0x01	Commission Write command Response
0x02	Commission Read command Request
0x03	Commission Read command Response
0x04 to 0xFF	Reserved

List of Commission Attributes

Attribute ID Name	**Attribute ID**	**Attribute Length**	**Range**
PAN ID	0x00	2	0 to 0xFFFF
Channel	0X01	1	O to 8
Device Type	0x02	1	1 – Root 2 - Router
IPv6 Prefix	0x03	8	As per IPv6 specifications
AES Key	0X04	16	Hex 16 bytes
Commission State	0X18	1	0 – Un-commissioned 1 – Commissioned
DAG ID	0x19	16	As per IPv6 specifications
Router List	0x1A	N/A	List of 4 byte IPv6 address with the first 12 byte elided.
Number of routers	0x1B	3	Count of routers added in the ROOT.
Other ID values	Reserved		

Note 1: Attribute PAN ID, channel, Device type, IPv6 Prefix, AES key are mandatory while commissioning ROOT device.

Note 2: Restart command should be sent after writing all attributes in Note 1. If restart command is received before writing all attributes in Note 1, response to restart command should be failure.

Note 3: Attributes 'commission state', 'DAG ID', 'Number of routers' should be read only. DAG ID should be IPv6 address of ROOT device which is combination of IPv6 prefix & MAC address.

Packet Structure of request to write commissioning attributes :

1-byte Frame Type	1-byte Sequence no	1- byte Command ID	1-byte Attribute count	1- byte Attribute ID1	Attribute ID1 value	1- byte Attribute ID'n	Attribute ID'n value

Example :

|00 | 02 |00 |05| 00 |12 34 | 01 | 02 | 02|01|03 | CC CCCCCCCCCCCCCC| 04 |00 00 00 00 00 00 00 00 00 00 4D 53 45 44 43 4C |

00 : Frame type Commissioning Read/Write

02 : Sequence Number

00 : Command ID – Commissioning Write request

05 : Attribute Count

00 : Attribute ID 1 – Short PAN ID

12 34 : Short PAN ID value

01 : Attribute ID 2 – Channel

02 : Channel Value

02: Attribute ID 3 – Device Type

01: Device type value

03 : Attribute ID 4 – IPv6 prefix

CC CCCCCCCCCCCCCC : IPv6 prefix value

04 : Attribute ID 4 – AES Key

00 00 00 00 00 00 00 00 00 00 4D 53 45 44 43 4C : AES key 16 byte value

Commissioning packet response (Success):

1-byte Frame Type	1- byte Sequence no	1- byte Command ID	Status Field

Example

| 02 | 02 | 01 | 00 |

02 : Frame type – Commission Read/write Response

02 : Sequence Number

01 : Command ID Commission Write command Response

Value : 0x00 Success, non zero is failure

Note 4:

Command ID success is indicated by status code as zero. Failure shall be indicated with failed attribute and status. Fail Attribute Status is one for failure.

Commissioning packet failure response :

1-byte Frame Type	1-byte Sequence no	1-byte Command ID	1-byte Status	1-byte Fail attribute ID	1-byte Fail Attribute Status

Example.

02 | 02 | 01 |01| 00| 01 |

02 : Frame type – Commission Read/write Response

02 : Sequence Number

01 : Command ID – Commission Write Response

01 : Status - failure

00: Fail Attribute ID 0x00 (PAN ID)

01: Status - Fail

Packet Structure for reading commissioning attributes :

1-byte Frame Type	1-byte Sequence no	1-byte Command ID	1-byte Attribute count	1- byte Attribute ID1	1- byte Attribute ID2	…… …… …… ……	Attribute ID'n

Example :

|00 | 02 |02 |04| 00 |01 | 02 | 03 |

00 : Frame type Commissioning Read/Write

02 : Sequence Number

02 : Command ID – Commissioning Read request

04 : Attribute Count

00 : Attribute ID 1 – Short PAN ID

01 : Attribute ID 2 – Channel

02 : Attribute ID 3 – Device Type

03: Attribute ID4- IPv6 prefix value

Packet structure of response to the command to read commissioning attributes :

1-byte Frame Type	1-byte Sequence no	1- byte Command ID	1-byte Attribute count	1- byte Attribute ID1	**Attribute 1 read status**	Attribute 1 value	Attribute n ID	Attribute ID'n read status

|02 | 02 |03 |04| 00 |00|12 34 | 01 |00| 02 | 02 |00| 01|03 |00|CC CC CCCCCCCCCCCC |

02 : Frame type Commissioning Read/Write

02 : Sequence Number

03 : Command ID – Commissioning Read request

04 : Attribute Count

00 : Attribute ID 1 – Short PAN ID

00: Read Status of attribute ID1 : Value 0= success, non-zero value for failure.

12 34 : Short PAN ID value

01 : Attribute ID 2 – Channel

00: Read Status of attribute ID2

02 : Channel Value

02 : Attribute ID 3 – Device Type

00: Read Status of attribute ID3

01: Device Type

03 : Attribute ID 4 – IPv6 prefix value

00: Read Status of attribute ID4

CC CCCCCCCCCCCCCC : IPv6 prefix value

Router List write Request:

1-byte Frame Type	1-byte Sequence no	1-byte Command ID	1-byte Attribute count	1-byte Attribute ID	1–byte Add /Remove	1-byte Routers count	4-byte Router Address 1	- - -	4-byte Router Address n

| 00 | 02 | 00 | 01 | 1A | 00| 05 | 00 00 02 01 | 00 00 02 02 | 00 00 02 03 | 00 00 02 04 | 00 00 02 05 |

Note 5: Values for 1-byte add/remove field should be 00 for adding & 01 for removing router addresses.

Note 6: The router IPv6 addresses have their most significant 12 bytes elided. The 4-byte router addresses to be written into the ROOT device should be unique. In case of duplication of router addresses, response should be given as failure.

Example Router List write Response:

1-byte Frame Type	1-byte Sequence no	1-byte Command ID	Status

| 02 | 02 | 01 |00

Note 7:

Command ID zero for success, Failure with failed attribute and status, Fail Attribute Status one for failure.

1-byte Frame Type	1-byte Sequence no	1-byte Command ID	1-byte Failed attribute ID	1-byte Attribute Status

Example: | 02 | 02 |01|01|00|01|

Reading of list of routers added in Root device :

Before reading the router list, number of routers added in Root device should be downloaded using attribute 1B.

Packet structure of request to read number of routers added in ROOT :

The packet structure should be similar to commissioning packet read request.

Example:

|00 | 02 |02 |01| 1B|

00 : Frame type Commissioning Read/Write

02 : Sequence Number

02 : Command ID – Commissioning Read request

01 : Attribute Count

1B : Attribute ID 1 – Number of routers present in the Root device.

Depending upon the number of routers present in Root device, the request to read the router list should be formatted. The packet structure to read router list is as below.

Router List Read Request:

1-byte Frame Type	1-byte Sequence no	1-byte Command ID	1-byte Attribute count	1-byte Attribute ID	1-byte Routers count	1-byte Index

Example:

The command to download first 5 router addresses should be as below.

| 00 | 02 | 02 | 01 | 1A | 05 |00|

00 : Frame type Commissioning Read/Write

02 : Sequence Number

02 : Command ID – Commissioning Read request

01 : Attribute Count

1A : Attribute ID 1 –Router list added in the Root device.

05: Count of router addresses to be read.

00: Index- router addresses starting from 0th address

If the response to router list read command should not be sent in single packet, the router list should be downloaded in batches. HHT/DCU application should change the values for fields “count of routers” & “index” accordingly.

Example:

To download router list of 35 devices, HHT/DCU application may download the list of 20 devices first and in next batch remaining devices will be downloaded.

The commands given should be as below.

| 00 | 02 | 02 | 01 | 1A | 14 |00|

This command should return first 20 router addresses (0-19) starting from 0th address.

| 00 | 02 | 02 | 01 | 1A | 0E |14|

This command should return remaining 15 router addresses (20-34) starting from 20th address.

Router List Read Response:

1-byte Frame Type	1-byte Sequence no	1-byte Command ID	1-byte Attribute count	1-byte Attribute ID	Read Status Attribute ID1	1-byte Routers count	4-byte Router Address 1	- - -	4-byte Router Address n

Example:

The response to command | 00 | 02 | 02 | 01 | 1A | 14 |00| should be

|02| 02| 03| 01| 1A| 00| 14| 00 01 32 01| 00 01 32 02| 00 01 32 03| 00 01 32 04| 00 01 32 05| 00 01 32 06| 00 01 32 07| 00 01 32 08| 00 01 32 09| 00 01 32 10| 00 01 32 11| 00 01 32 12| 00 01 32 13| 00 01 32 14| 00 01 32 15| 00 01 32 16| 00 01 32 17| 00 01 32 18| 00 01 32 19| 00 01 32 20|

02 : Frame type Read/Write commission response

02 : Sequence Number

03 : Command ID – Commissioning Read response

01 : Attribute Count

1A : Attribute ID 1 –Router list added in the Root device.

00 : Read status of attribute ID1. Value 0 for success, non-zero value for failure

14: count of router addresses sent

00 01 32 01: 1st router address

……

Restart command:

1-byte Frame Type	1- byte Sequence no	2 - byte Delay restart value in seconds

Example : |01 | 02| 00 0A |

Restart Response:

1-byte Frame Type	1- byte Sequence no	1 byte Status

Example : | 03 | 02 | 00 |

APPLICATION LAYER

MSEDCL ZigBee document attribute list as specified in Annexure VI. Over the Air payload structure, data types information, profile ID, cluster ID, end point information should be the same as legacy ZigBee implementation.

ANNEXURE – V

RF METERING PROTOCOL - THREE PHASE RF METER

Protocol Version 2.1

1. Scope and Purpose

This section specifies a single cluster, the Maharashtra State Electricity Distribution Company Limited (MSEDCL) cluster, which provides representation of data elements. It is in intention that multiple meter manufactures intending to provide product for Indian state of Maharashtra support the attributes listed below in its entirety.

2. Introduction

This document facilitates the representation and exchange of data elements and are to be supported by multiple meter manufacturers.

3. Attributes

For convenience, the attributes defined in this specification are arranged into sets of related attributes; each set can contain multiple attributes. Attribute identifiers are encoded such that the most significant byte specifies the attributes set and the least significant byte specifies the attribute within the set. The currently defined attribute sets are listed in the table below.

Attribute Set Identifier	**Description**
0x00	Meter Information
0x01	Cumulative Active Energy
0x02	Maximum Demand
0x03	Tamper Information (Set1)
0x04	Time zone wise Cumulative Active Energy
0x05	Time zone wise Maximum Demand
0x06	Load Profile
0x07	Power on/off events

0x08	Tamper Information (Set2)
0x09	Cumulative Apparent Energy
0x0A	Time zone wise Cumulative Apparent Energy
0x0B	Cumulative Reactive Energy
0x0C	Time zone wise Cumulative Reactive Energy
0x0D-0xff	Reserved

3.1. Meter Information Attribute Set (0x00XX)

The attributes that are used in the Meter Information attribute Set are summarized in the below table. Some of these attributes overlap with functionality provided on the Basic cluster. Information presented by these attributes should be mirrored on the Basic cluster.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	Serial Number	Character string	8 bytes	Read only	M
0x01	Make code	Character string	5 bytes	Read only	M
0x02	Meter time	UTC Time	4 bytes	Read only	M
0x03	Protocol Version	Unsigned 16 bit Integer	2 bytes	Read Only	M
0x004	Meter Phase	Unsigned 8 bit Integer	1 bytes	Read Only	M
0x005	Vendor ID	Unsigned 8 bit Integer	1byte	Read only	M
0x06	Tamper Present Status	Unsigned 32 bit Integer	4 bytes	Read Only	M
0x09	Instantaneous	Unsigned	2 bytes	Read	M

	Voltage (R Phase)	16 bit Integer		Only	
0x0A	Instantaneous Voltage (Y Phase)	Unsigned 16 bit Integer	2 bytes	Read Only	M
0x0B	Instantaneous Voltage (B Phase)	Unsigned 16 bit Integer	2 bytes	Read Only	M
0x0C	Instantaneous Current (R Phase)	Unsigned 16 bit Integer	2 bytes	Read Only	M
0x0D	Instantaneous Current (Y Phase)	Unsigned 16 bit Integer	2 bytes	Read Only	M
0x0E	Instantaneous Current (B Phase)	Unsigned 16 bit Integer	2 bytes	Read Only	M

3.1.1. Serial Number Attribute

This attribute is a character string representing the serial number of the meter.

3.1.2. Make Code Attribute

This attribute is a character string representing the make code of the meter.

3.1.3. Meter Time

This attribute returns the time currently seen in the meter.

3.1.4. Protocol Version

This attribute returns the protocol version seen in the meter. Protocol version is 2.1.

3.1.5. Meter Phase

This attribute returns the meter type of the meter. 0x01 is for single phase and 0x03 for three phase

3.1.6. Vendor ID

This attribute returns the vendor ID of the supplier set in the meter.

3.1.7. Tamper Present Status

This attribute returns the time currently seen in the meter.

Tamper Present Status field shall have 32 bits bitmap indicating which tampers have occurred. When no tamper has occurred, the status shall be set as 0, else the specific tamper bit will be set to 1. Once the tamper specific bit is set to 1 after occurrence of tamper, this bit should not be set to 0 after restoration of that tamper. The meter reading software shall check the tamper present and download related tamper information as specified in the document. Bits corresponding to tampers not applicable for three phase meters shall be always set to 0.

Example : 0000 0000 0000 00000000 0000 0001 0101

Tamper Description	Bit Position	Tamper Present
Reversal of Phase and Neutral	1	Y
Load through Local Earth	2	N
Neutral Disconnect	3	Y
Magnetic Tamper	4	N
Meter Cover Open	5	Y
EMI/EMC Field Tamper	6	N
Missing Potential	7	N
Current Imbalance	8	N
Current Reversal	9	N
Current Short Circuit	10	N
High Neutral Current	11	N
Potential Imbalance	12	N
Reserved	13	-

Reserved	-	-
Reserved	32	-

3.1.8. Instantaneous Voltage (Phase wise)

This attribute returns phase wise voltage values. Voltage should be measured with no decimal values.

3.1.9. Instantaneous Current (Phase wise)

This attribute returns phase wise current values. Current should be measured in multiple of 10mA.

3.2. Cumulative Active Energy Attribute Set (0x01XX)

This attributes that are used in the Cumulative Active Energy Attributes are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	Cumulative Active Energy	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x01 - 0x0C	Cumulative Active Energy of Previous Month 1-12	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M

3.2.1. Cumulative Active Energy

These attributes give the current cumulative active energy value for the meter. The value is a fixed point value of 0.1 kWh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kWh.

3.2.2. Cumulative Active Energy of previous Months 1-12

These attributes give the historic consumption information for previous months. The value is a fixed point value of 0.1 kWh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert

from the unsigned integer representation to the true decimal value in kWh.

3.3. Maximum Demand Attribute set (0x02XX)

The attributes that are used in the Maximum Demand Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	Maximum Demand of Current Month	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x01	Maximum Demand of Current Month Timestamp	UTC Time	4 bytes	Read only	M
0x02	Maximum Demand of Current Month 1	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x03	Maximum Demand of Current Month 1 Timestamp	UTC Time	4 bytes	Read only	M
0x04	Maximum Demand of Current Month 2	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x05	Maximum Demand of Current Month 2 Timestamp	UTC Time	4 bytes	Read only	M
0x06	Maximum Demand of Current	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M

	Month 3				
0x07	Maximum Demand of Current Month 3 Timestamp	UTC Time	4 bytes	Read only	M
0x08	Maximum Demand of Current Month 4	Unsigned 16-bit Integer	0x0000 – 0xffff	Read only	M
0x09	Maximum Demand of Current Month 4 Timestamp	UTC Time	4 bytes	Read only	M
0x0a	Maximum Demand of Current Month 5	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x0b	Maximum Demand of Current Month 5 Timestamp	UTC Time	4 bytes	Read only	M
0x0c	Maximum Demand of Current Month 6	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x0d	Maximum Demand of Current Month 6 Timestamp	UTC Time	4 bytes	Read only	M
0x0e	Maximum Demand of Current Month 7	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x0f	Maximum Demand of Current	UTC Time	4 bytes	Read only	M

	Month 7 Timestamp				
0x10	Maximum Demand of Current Month 8	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x11	Maximum Demand of Current Month 8 Timestamp	UTC Time	4 bytes	Read only	M
0x12	Maximum Demand of Current Month 9	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x13	Maximum Demand of Current Month 9 Timestamp	UTC Time	4 bytes	Read only	M
0x14	Maximum Demand of Current Month 10	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x15	Maximum Demand of Current Month 10 Timestamp	UTC Time	4 bytes	Read only	M
0x16	Maximum Demand of Current Month 11	Unsigned 16-bit integer	0x0000 – 0xffff	Read only	M
0x17	Maximum Demand of Current Month 11 Timestamp	UTC Time	4 bytes	Read only	M
0x18	Maximum Demand of	Unsigned 16-bit	0x0000 – 0xffff	Read only	M

	Current Month 12	integer			
0x19	Maximum Demand of Current Month 12 Timestamp	UTC Time	4 bytes	Read only	M

3.3.1. Maximum Demand of Current Month

This attributes give the maximum demand for the current month. The value is a fixed point value of 0.1 kVA encoded as an unsigned 16-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in KVA. Invalid values are given as 0xffff.

3.3.2. Maximum Demand of current Month Timestamp

These attributes give a timestamp for when the maximum demand of the current month occurred. An invalid value is given as 0xffffffff.

3.3.3. Maximum Demand of Previous Months 1-12

These attributes give the historic maximum demand information for previous months. The value is a fixed value of 0.1 kVA encoded as an unsigned 16-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kVA. Invalid values are given as 0xffff.

3.3.4. Maximum Demand of previous Months Timestamp 1-12

These attributes give the timestamp for when the historic maximum demand occurred for previous months. An invalid value is given as 0xffffffff.

3.4. Tamper information Attribute Set1 (0x03XX)

The attributes that are used in the Tamper Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00 – 0x09	Latest 10 Tamper Events – Missing Potential	Structure	11 bytes	ReadOnly	M
0x10 - 0x19 0x0a – 0x0F 0x1a – 0x1f	Reserved				
0x20 – 0x29	Latest 10 tamper Events – Current Imbalance	Structure	11 bytes	ReadOnly	M
0x30 – 0x39 0x2a – 0x2f 0x3a – 0x3f	Reserved				
0x40 – 0x49	Latest 10 Tamper Events – Current Reversal Start (0x4x) and Stop (0x5x) times	Structure	11 bytes	ReadOnly	M
0x50 – 0x59 0x4a –	Reserved				

0x4f 0x5a – 0x5f					
0x60 - 0x69	Latest 10 tamper events – Current Short circuit	Structure	11 bytes	ReadOnly	M
0x70 – 0x79 0x6a – 0x6f 0x7a – 0x7f	Reserved				
0x80	Meter Cover Open	UTC Time	11 bytes	ReadOnly	M
0x90 – 0x99	Latest 10 Tamper events – High Neutral Current	Structure	11 bytes	ReadOnly	M
0xa0 – 0xa9 0x9a – 9f 0xaa – 0xaf	Reserved				
0xb0 – 0xb9	Latest 10 Tamper events – Potential imbalance	Structure	11 bytes	ReadOnly	M
0xc0 – 0xc9 0xba – 0xbf 0xca – 0xcf	Reserved				
0xd0 – 0xd9	Latest 10 Tamper events – Magnetic	Structure	11 bytes	ReadOnly	M

	Tamper				
0xe0 - 0xe9 0xda – 0xdf 0xea – 0xef	Reserved				

Single tamper record will be structure consisting of the following fields.

Field name	**Type**
Phase	Unsigned 8 bit integer (1 byte)
Occurrence date	UTC time (4 bytes)
Restoration date	UTC time (4 bytes)

In structure data type 2 bytes are reserved to indicate number of elements in structure. Total data length is 11 bytes

3.4.1. Latest 10 Tamper Event Attributes

These attributes represents tamper events on the meter. There are 10 events for each event type. Each incrementing attributes index corresponds to one event further in the past. The attribute should return phase on which event is occurred and restored and time stamp for occurrence and restoration of event. The values for phase should be as below.

Type of phase	Value
No phase	0x00
R Phase	0x01
Y Phase	0x02
B Phase	0x03

The application layer frame format of response to download two events of potential missing should be as below.

|00|08|00 FC|0D BF|08|00|18|02|0E|00 03|00|4C|03|00|20|01|E2| 80 EF 9A 22 |E2|E0 62 9A 22|

00 - Frame control

08 – Destination end point

00 FC – Cluster ID

0D BF – Profile ID

08 – Source end point

00 - APS counter

18 - Frame control

02 – Sequence Number

0E-Command identifier (Read attributes structured)

00 03 – Attribute ID to download tamper

00 – Status Success

4C – Data Type (Structure)

03 00 – Number of Attributes in Structure

20|01| E2| 80 EF 9A 22 |E2|E0 62 9A 22– is tamper data

20|01 Attribute 1 phase on which tamper occurred/restored

20 – Data Type (Unsigned 8-bitinteger)

01 – R phase on which tamper occurred/restored.

| E2| 80 EF 9A 22 | Tamper Occurrencetimestamp

E2- Data type (UTCTime)

80 EF 9A 22 – Data Value (Occurrence timestamp)

| E2| E0 62 9A 22 | Tamper Restorationtimestamp

E2- Data type (UTCTime)

E0 62 9A 22 – Data Value (Restoration timestamp)

3.4.2. Meter Cover Open

This attribute shall return phase and timestamp for the last time the meter coverwas opened. As phase is not applicable for this tamper, value

for phase should be returned as 0x00 An invalid event i.e. restoration timestamp is encoded as 0xE2ffffffff .Total response should be given as0x2000E280EF9A22E2FFFFFF.

3.5. Tamper information Attribute Set2 (0x08XX)

The attributes that are used in the Tamper Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00-0x09	Latest 10 Tamper Events – ESD Tamper	Structure	11 bytes	Read only	M
0x10-0x19	Reserved				

This attribute represents ESD tamper events on the meter. The attribute shall return phase on which event is occurred and restored and time stamp for occurrence and restoration of event. If the meter is immune then response should be given as 0x2000E2ffffffffE2ffffffff.

3.6. Time Zone wise Active Energy Attributes Set (0x04XX)

The attributes that are used in the Time Zone wise Active Energy attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	TZ1 Active Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x01	TZ2 Active Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x02	TZ3 Active Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x03	TZ4 Active	Unsigned 32- bit	0x00000000 -0xffffffff	Read only	M

	Energy	integer			

3.6.1. Time zone wise Active Energy

These attributes give the time zone wise current cumulative active energy value for the meter. The value is a fixed point value of 0.1 kWh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kWh.

3.7. Time Zone wise Maximum Demand Attribute Set (0x05XX)

The attribute that are used in the Time zone wise Maximum Demand Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	TZ1 Maximum Demand	Unsigned 16-bit integer	0x0000-0xffff	Read only	M
0x01	TZ1 Maximum Demand Timestamp	UTC Time	4 bytes	Read only	M
0x02	TZ2 Maximum Demand	Unsigned 16- bit integer	0x0000-0xffff	Read only	M
0x03	TZ2 Maximum Demand Timestamp	UTC Time	4 bytes	Read only	M
0x04	TZ3 Maximum Demand	Unsigned 16- bit integer	0x0000-0xffff	Read only	M
0x05	TZ3 Maximum Demand Timestamp	UTC Time	4 bytes	Read only	M

0x06	TZ4 Maximum Demand	Unsigned 16- bit integer	0x0000-0xffff	Read only	M
0x07	TZ4 Maximum Demand Timestamp	UTC Time	4 bytes	Read only	M

3.7.1. Time zone wise Maximum Demand

This attributes give the time zone wise maximum demand for the current month. The value is a fixed point value of 0.1kVA encoded as an unsigned 16- bit integer. It should be divided by 10 in order to convert from the unsigned integration representation to the true decimal value in kVA. Invalid values are given as 0xffff.

3.7.2. Time zone wise Maximum Demand Timestamp

These attributes give a timestamp for when the maximum demand of the corresponding time zone occurred. An Invalid value is given as 0xffffffff.

3.8. Load Profile Attributes Set (0x06XX)

Attribute Set ID 0x06, attribute ID 0x00 will be used to retrieve load survey data. The attribute ID 0x0600 should be followed by 2 byte index (0xXXXX) which shall be used to access the intervals. The most recent interval shall be accessed by index value 0x0000 and increasing values of index shall be used to access previous intervals.

Load Profile

Identifier	Index	Name	Type	Range	Access	Mandatory / Optional
0x00	0xXXXX	Load Survey	Set	32 bytes	Read Only	M

Load profile shall be maintained for the previous 60 days on a power on basis. The values shall be integrated for 30 Minutes and the following parameters stored. The thirty minute record will be maintained as a record consisting of the following fields.

Field name	Type
Interval start time	UTC time
kWh	Unsigned 32 bit integer
kVArh (Lag)	Unsigned 32 bit integer
kVArh (Lead)	Unsigned 32 bit integer
kVAh	Unsigned 32 bit integer
Voltage - V_{RN}	Unsigned 16 bit integer
Voltage - V_{YN}	Unsigned 16 bit integer
Voltage – V_{BN}	Unsigned 16 bit integer
Current - I_R	Unsigned 16 bit integer
Current - I_Y	Unsigned 16 bit integer
Current – I_B	Unsigned 16 bit integer

Unsigned 32 bit integer values should be divided by 10 in order to convert unsigned integer representation to true decimal value.

The voltage value will be the measured voltage with no decimal values.

The current will be in multiples of 10mA.

For example, 1.540A will be represented as 154

60 A will be represented as 6000.

3.9. Power On/OFF events Attribute set (0x07XX)

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00 – 0xff	Power OFF /On events - Timestamp	UTC Time	4 bytes	ReadOnly	M

Power ON/OFF events, should always be made available with the first event always being a power OFF event and subsequent event in power ON. Thus all odd events should be always Power OFF event and all even events should be always Power ON events.

3.10. Cumulative Apparent Energy Attribute Set (0x09XX)

This attributes that are used in the Cumulative Apparent Energy Attribute set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	Cumulative Apparent Energy	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x01 - 0x0C	Cumulative Apparent Energy of Previous Month1-12	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M

3.10.1. Cumulative Apparent Energy

These attributes give the current cumulative apparent energy value for the meter. The value is a fixed point value of 0.1 kVAh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kVAh.

3.10.2. Cumulative Apparent Energy of previous Months 1-12

These attributes give the historic consumption information for previous months. The value is a fixed point value of 0.1 kVAh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kVAh.

3.11. Time Zone wise Apparent Energy Attributes Set (0x0AXX)

The attributes that are used in the Time Zone wise Apparent Energy Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	TZ1 Apparent	Unsigned 32- bit	0x00000000 -0xffffffff	Read only	M

	Energy	integer			
0x01	TZ2 Apparent Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x02	TZ3 Apparent Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x03	TZ4 Apparent Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M

3.11.1. Time zone wise Apparent Energy

These attributes give the time zone wise current cumulative apparent energy value for the meter. The value is a fixed point value of 0.1 kVAh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kVAh.

3.12. Cumulative Reactive Energy Attribute Set (0x0BXX)

This attributes that are used in the Cumulative Reactive Energy Attribute set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	Cumulative Reactive Energy(Lag) Current month	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x01	Cumulative Reactive Energy(Lead) Current month	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x02	Cumulative Reactive Energy(Lag) Previous month1	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M

0x03	Cumulative Reactive Energy(Lead) Previous month 1	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x04	Cumulative Reactive Energy(Lag) Previous month2	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x05	Cumulative Reactive Energy(Lead) Previous month 2	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x06	Cumulative Reactive Energy(Lag) Previous month3	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x07	Cumulative Reactive Energy(Lead) Previous month 3	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x08	Cumulative Reactive Energy(Lag) Previous month 4	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x09	Cumulative Reactive Energy(Lead) Previous month 4	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x0a	Cumulative Reactive Energy(Lag) Previous month 5	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x0b	Cumulative Reactive	Unsigned 32-bit	0x00000000 – 0xffffffff	Read only	M

	Energy(Lead) Previous month 5	integer			
0x0c	Cumulative Reactive Energy(Lag) Previous month 6	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x0d	Cumulative Reactive Energy(Lead) Previous month 6	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x0e	Cumulative Reactive Energy(Lag) Previous month 7	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x0f	Cumulative Reactive Energy(Lead) Previous month 7	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x10	Cumulative Reactive Energy(Lag) Previous month 8	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x11	Cumulative Reactive Energy(Lead) Previous month 8	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x12	Cumulative Reactive Energy(Lag) Previous month 9	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x13	Cumulative Reactive Energy(Lead) Previous	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M

	month 9				
0x14	Cumulative Reactive Energy(Lag) Previous month 10	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x15	Cumulative Reactive Energy(Lead) Previous month 10	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x16	Cumulative Reactive Energy(Lag) Previous month 11	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x17	Cumulative Reactive Energy(Lead) Previous month 11	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x18	Cumulative Reactive Energy(Lag) Previous month 12	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M
0x19	Cumulative Reactive Energy(Lead) Previous month 12	Unsigned 32-bit integer	0x00000000 – 0xffffffff	Read only	M

3.12.1. Cumulative Reactive Energy (Lag/Lead)

These attributes give the current& historic months cumulative reactive energy (Lag/Lead) value for the meter. The value is a fixed point value of 0.1 kVArh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kVArh.

3.13. Time Zone wise Reactive Energy Attributes Set (0x0CXX)

The attributes that are used in the Time Zone wise Reactive Energy Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	TZ1 Reactive Energy(Lead)	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x01	TZ1 Reactive Energy(Lag)	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x02	TZ2 Reactive Energy(Lead)	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x03	TZ2 Reactive Energy(Lag)	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x04	TZ3 Reactive Energy(Lead)	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x05	TZ3 Reactive Energy(Lag)	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x06	TZ4 Reactive Energy(Lead)	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M
0x07	TZ4 Reactive Energy(Lag)	Unsigned 32- bit integer	0x00000000 -0xffffffff	Read only	M

3.13.1. Time zone wise Reactive Energy

These attributes give the time zone wise current cumulative reactive energy value for the meter. The value is a fixed point value of 0.1 kVArh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kVArh.

Note: For any attribute other than attributes defined in this annexure, meter should give response as 'Unsupported attribute' with attribute status as '0x86'. The application layer frame format of response for Unsupported attribute 0x 0D 00should be as below.

|00|08|00FC|0DBF|08|00|18|02|01|000D|86|

00 - Frame control

08 – Destination end point

00 FC – Cluster ID

0D BF – Profile ID

08 – Source end point

00 - APS counter

18 - Frame control

02 – Sequence Number

01-Command identifier (Read attributes response)

0D 00 – Attribute ID

86 – Status (Unsupported attribute)

Part II : Interoperability

The objectives of MSEDCL:

1) Interoperability with any make of meter; any make of radio module
2) Mesh networking with hopping
3) Systems should be ready for future AMR
4) Standardization.

- The meter based on 6LoWPAN and HHT shall be based on both open Zigbee 2007 PRO and 6LoWPAN
- The bidder shall support Simple Metering Cluster and related attributes from the Smart Energy profile of ZigBee Pro, on a manufacturer specific profile that has been defined in the document "ZigBee Automated Metering Initiative Profile" which represents data previously covered by the MSEDCL protocol; this cluster may be implemented by all meter vendors for interoperability

Interoperability in the field

- The HHT should be able to act as a ZigBee Coordinator /6LoWPAN root in order to facilitate the installation & commissioning of meters. The devices are combo devices, capable of commissioning a network and also act as routers/end device to download data.
- Meter devices shall join the ZigBee Global Commissioning PAN (0x0050C27710000000) formed by HHU. The HHU shall then configure meter devices for the destination operating network by use of the ZigBee Cluster Library's Commissioning cluster. Devices shall then be instructed to leave the ZigBee Global Commissioning PAN and join the new network. If the new operating PAN has not been started, the HHU shall start the new network, commissioning an energy meter as a coordinator for that new PAN. If for any reason the new operating PAN is not accessible the meter should return to factory defaults.

Note:

All settings provided for Zigbee devices specified in the tender document are only for tender samples. The proper settings will be communicated to successful bidder.

Part III : Setting Critical Parameters

The purpose of this document is to specify a protocol sequence for certain operations.

These operations involve setting critical parameters in the meters.

1) Change the password in the meter

2) Reset of Maximum Demand.

3) Set the number of TOD slots and their durations.

4) Set meter time (RTC).

5) Set MD integration period

For the aforementioned purposes, the following parameters and protocol sequences are specified.

Protocol Sequences.

1) Change of password in the meter.

The default password in the meter shall be the meter's serial number. The following packets shall be sent from the HHU to the meter.

Packet 1:
Attribute ID: 0x0000
Attribute type: String type
Attribute length: 6 – 20 bytes
Description: Old password.
Attribute ID: 0x0001
Attribute type: string type
Attribute length: 6 – 20 bytes
Description: New password.
Packet 2:
To be issued within 120 seconds of Packet 1:
Attribute ID: 0x0002
Attribute type: string type
Attribute length: 6 – 20 bytes
Description: New Password Reconfirm.

The HHU software should have front end display capability to take the necessary inputs, give prompts to users. Automatic extensions, forms, saves etc should not be implemented in HHU.
The meter shall reset the password on successful completion of sequence. If the reconfirm packet is not received in the timeout provided, the new password will be discarded and the old one retained. If the old password does not match, the password will not be changed.

2) Protocol sequence for reset MD.

Packet 1:

Attribute ID: 0x0000
Attribute type: string type
Attribute length: 6 – 20 bytes
Description: Password.
Attribute ID: 0x0004
Attribute type: No data type

3) Protocol sequence for TOD timeslot setting

Packet 1:

Attribute ID: 0x0000
Attribute type: string type
Attribute length: 6 – 20 bytes
Description: Password.
Attribute ID: 0x0005
Attribute type: Variable length array.
Attribute Description: The 0th element will be a 16 bit element consisting of the length of the array and the following elements will be of 8 bit unsigned integer type.The number in the 0th element lists the number of time of day (TOD) slots. The following array elements will describe the number of hours in each slot.

4) Protocol sequence for setting time in the meter.

Packet 1:

Attribute ID: 0x0000
Attribute type: string type
Attribute length: 6 – 20 bytes
Description: password.
Attribute ID: 0x0006
Attribute type: UTC Time.
Description: This command will set the RTC time in the meter.

5) Protocol sequence for settingMD integration & sub integration period in the meter.

Packet 1:

Attribute ID: 0x0000
Attribute type: string type
Attribute length: 6 – 20 bytes
Description: password.
Attribute ID: 0x0007
Attribute type: 8 bit unsigned integer.
The values for this attribute should be as below.

Value	Description
0x00	This value used to set MD integration period of 30 minutes & sub-integration period of 10 minutes
0x01	This value used to set MD integration period of 15 minutes & sub-integration period of 5 minutes

Attribute Description: This command will set MD integration period& sub integration period in the meter.

Application layer frame formats for response given by meter after setting of critical parameters should be as below.

i. **If critical parameter setting is successful**

If critical parameter setting is successful, following response should be given by meter.

|00|08|01 FC|0DBF|08|00|18|02|04|00|

00 - Frame control
08 – Destination end point
01FC – Cluster ID
0D BF – Profile ID
08 – Source end point
00 - APS counter
18 - Frame control
02 – Sequence Number
04-Command identifier (Write attributes response)
00 – Status (Critical parameter setting successful)

ii. **If critical parameter setting is not successful**

If the critical parameter setting is failed due to wrong meter password, following response should be given by meter.

|00|08|01FC|0DBF|08|00|18|02|04|7E|00 00|

00 - Frame control
08 – Destination end point
01FC – Cluster ID
0D BF – Profile ID
08 – Source end point
00 - APS counter
18 - Frame control
02 – Sequence Number
04- Command identifier (Write attributes response)
7E – Status (Critical parameter setting not successful due to wrong password)
00 00 – Attribute ID due to which critical parameter setting is failed.

if meter password is correct and still critical parameter setting is failed, following response should be given by meter.

|00|08|01 FC|0D BF|08|00|18|02|04|01|06 00|

00 - Frame control

08 – Destination end point

01 FC – Cluster ID

0D BF – Profile ID

08 – Source end point

00 - APS counter

18 - Frame control

02 – Sequence Number

04- Command identifier (Write attributes response)

01 – Status (Meter password is correct still critical parameter setting not successful due to attribute given next)

00 06 – Attribute ID for which critical parameter setting is failed.

ANNEXURE - VI

WORKING OF HHT APPLICATION FOR MSEDCL

1.0 ASSUMPTIONS:

The network is being implemented with two considerations.

- Meter reading through DCU (Data Concentrator Unit) in future. DCU / HHT will join the existing network as a router.
- Ease of meter installation and commissioning process.
- Meter Installers are different from Commissioning Technicians.
- Tamper Present status is always captured along with billing information.
- In case of response not received to HHT for tamper present status, HHT should store 'XXXX' in BILL.MRI. E.g. In old meters, supplied against earlier tenders, (no provision to record tamper present status) who do not return any response to tamper present status download command, the HHT should store 'XXXX' as a response for tamper present status.
- In old meters, supplied against earlier tender, EMI/EMC field tamper attributes are not implemented. HHT should retry three times for this tamper.

2.0 INTRODUCTION

2.1 Scope

MSEDCL would like to deploy RF enabled meters in Urban (high density of consumers) and rural area.

Along with RF Enabled meters, the system has following components:

1. BCS:

Base computer software used for communication with HHT. Stores commissioning and meter reading data.

2. Hand Held Terminal (HHT):

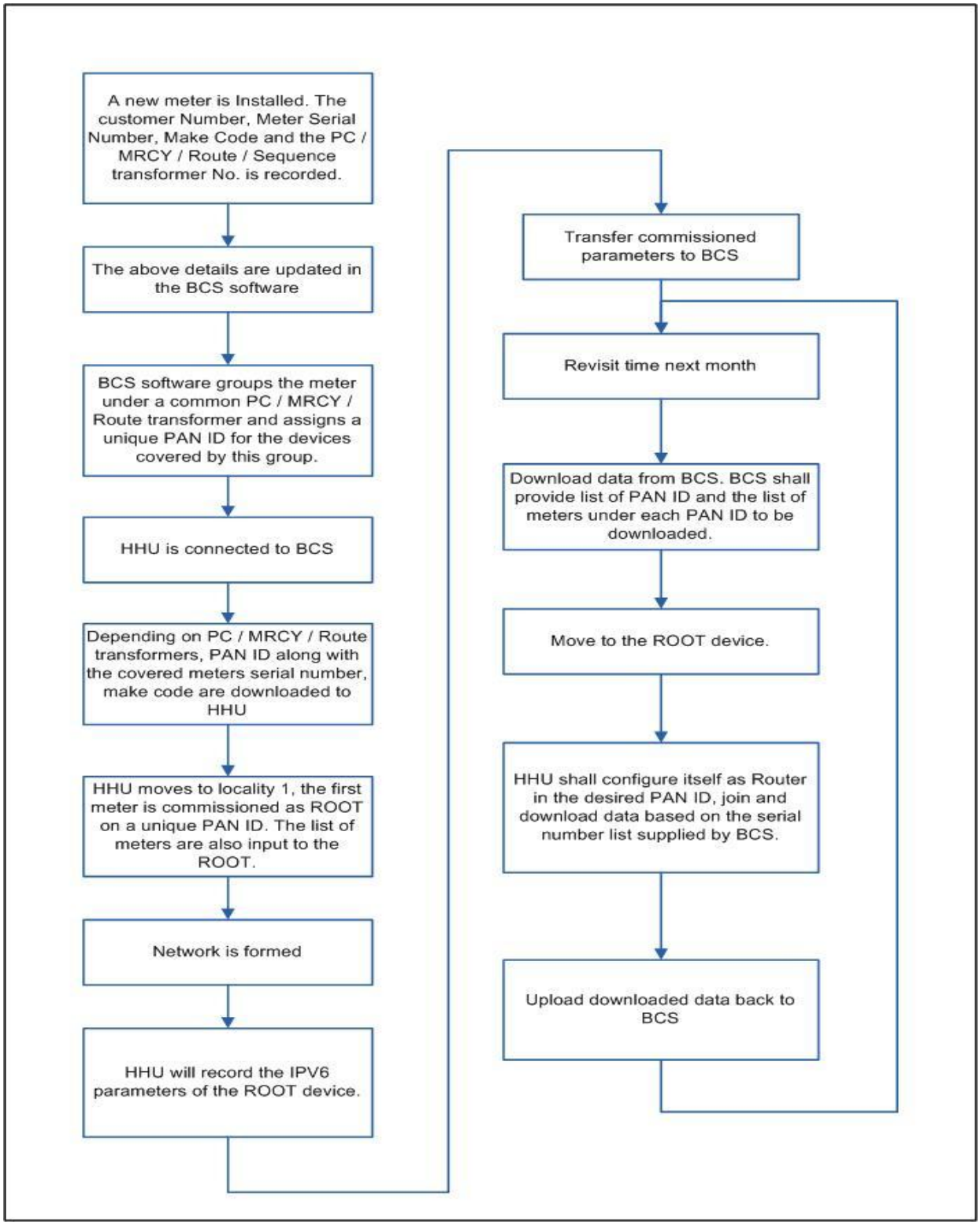
Used during commissioning phase and collects meter reading data thereafter.

This document explains the flow of the HHT software for commissioning and fetching data from these meters as per new commissioning and deployment strategy (reference "Commissioning and Deployment.doc") finalized by MSEDCL.

This Document restricts itself to explain the communication flow and data parameters to be transferred between HHT and BCS software.

Any other communication is out of scope of this document.

3.00 PROCESS FLOWCHART:



4.00 HHT FUNCTIONALITY:

4.01 Installation of meters

Whenever a meter is installed, the installation personnel are required to make note of the following information:

- Consumer Number
- Meter Serial Number & Make Code
- Meter Phase
- PC, MRCY, Route & Sequence
- Transformer Identity Number which services this particular meter.
- Any other customer identity / address.

The above data should then be entered into the BCS software.

4.02 6LoWPAN and Zigbee Network related BCS Functionality :

BCS shall group the meters (Serial Number & Make Code) separately based on their transformer details.

This classification is important since in future if MSEDCL goes the DCU way,

- Generate a pool of 64-bit PAN Id: Extended PAN Id of the network.

128-bit link key: Link key used for joining the network.

The HHT shall use a free PAN ID and link key and allot them for each network it commissions.

Adequate measures to be taken to ensure non duplication of ID's and other parameters.

4.03 6LoWPAN and Zigbee Network related HHT Functionality :

A HHT before going out has to be interfaced with the BCS software. On choosing the area where it is supposed to work for the day, the BCS shall send transfer the following data to HHT:

- Transformer Identities
- Meter Serial Number & Make Code of the meters that are serviced by the Transformer
- Pool of free PAN ID and Link Key

HHT broadly has two functions to perform in the field.

1. Commission newly deployed meters and create new networks as required.
2. Fetch data from the meters for which networks have already been created.

The process is explained below:

Meter Reader downloads the following details from BCS to HHT before going on the field.

- List of area & transformers to be covered.
- List of meters / serial number & make code that are serviced by the Transformer
- Pool of free PAN IDs and Link Keys
- Non-commissioned meters in the above list.
- List of free / unused networks which will be used for creating new networks. For the first time for a area the HHT will contain list of all unused networks only.

There are two scenarios that the HHT shall face

- First Visit
- Revisit

First Visit:

The HHT shall move to the meter in the field and commission the first meter as the 'coordinator' or 'root' depending upon band of operation i.e. Zigbee or 6LoWPAN, on a free PAN ID and Link Key. The following details shall be stored for transfer to the BCS:

- Serial Number & Make Code of the Meter
- Whether Coordinator or Router
- PAN ID
- Link Key
- Meter Phase
- Meter Type

Then the HHT addresses the nearby router, one after the other, and commissions them as routers in the just commissioned Network. These details too are stored for transfer to BCS at the end of the Day.

4.05 Revisit:

When the HHT is connected to the BCS, list of localities are offered to the HHT. On choosing the appropriate locality, the following details are downloaded to the HHT

- List of PAN ID, Link Key and meter serial number with make code under each PAN ID
- List of newly installed meters that need commissioning.

The HHT arrives at the location, commissions the new meters into available networks. The HHT the joins each network and downloads the required data.

4.06 Meter information:

For the newly commissioned meters following details will be stored in HHT, which will be later transferred to BCS software:

- Serial Number & Make Code of the Meter
- Whether Coordinator or Router or root
- PAN ID
- Link Key
- Meter Phase

4.07 Billing Information

HHT can download the billing data along with tamper present status from any meter. After joining the network, the data can be downloaded from any target meter in the network.

5.00 PROTECTION OF DATA:

HHT can be misplaced or stolen, such HHTs need to be de-restered. In order to protect the data stored in HHT, every HHT should have a unique serial number and HHT application should have a password.

6.00 MENUS OF HHU APPLICATION:

Refer Annexure-VIII for HHT Menu.

6.01 Facility in HHU:

Meter Reader on field will be able to perform following tasks from HHT:

Download Billing Data from all the meters in existing Network

Download Billing Data from un-commissioned Meters (Meters in Global PAN)

Commission newly installed meters – should automatically create a new network with a meter being commissioned as a coordinator if necessary.

Download Load Profile Data

Download Tamper Data

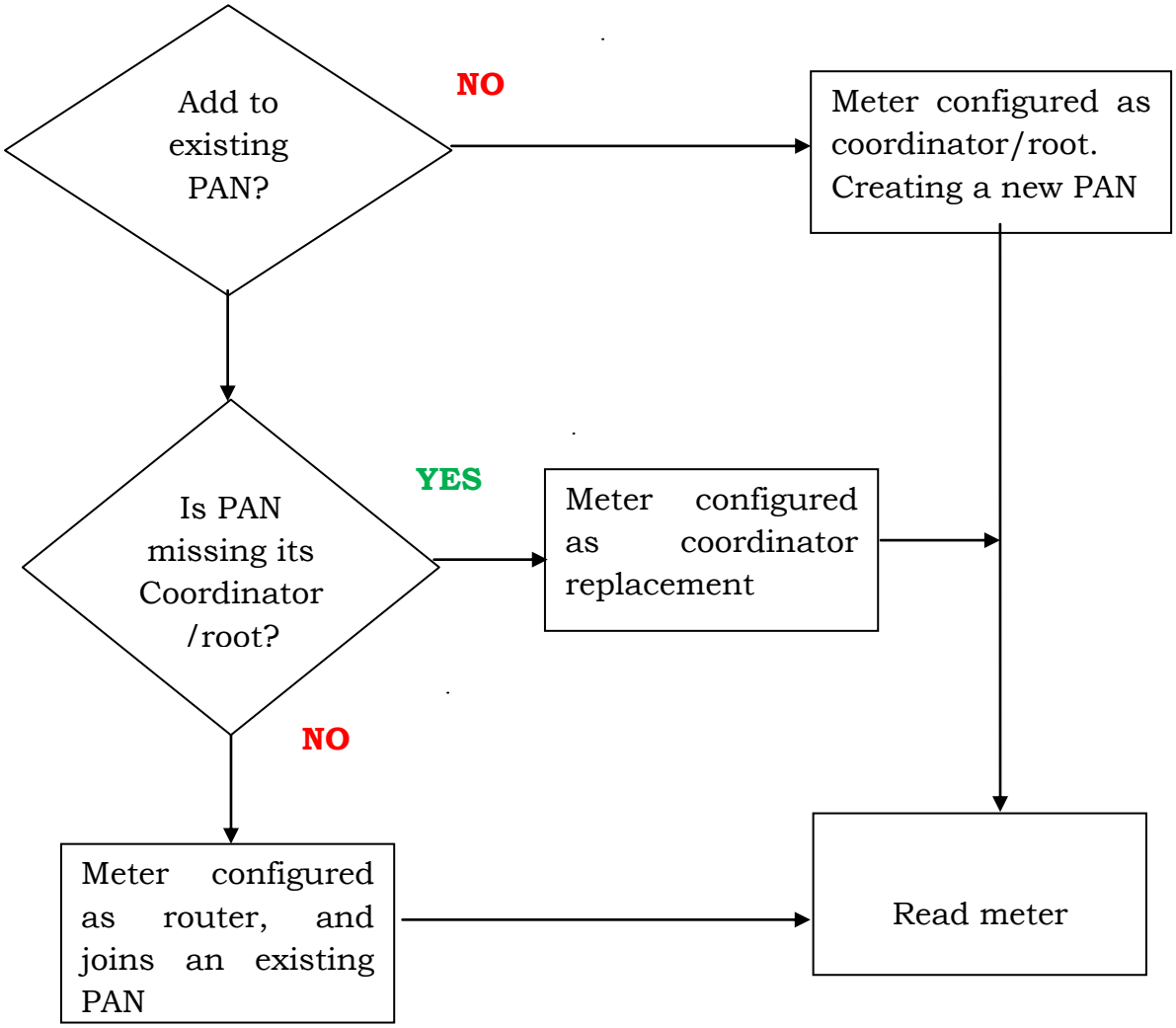
Download TOD Data

Reset Maximum Demand

Reset TOD Slots

Reset Corrupt RTC of Meter

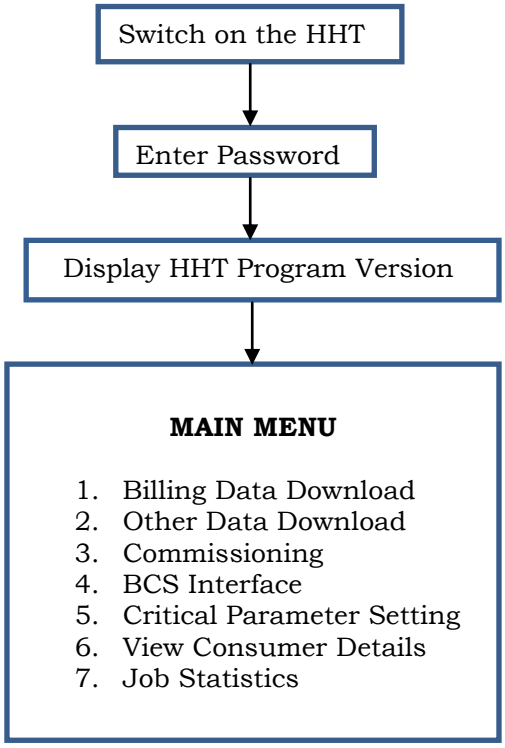
Commissioning & deployment - Flow Chart



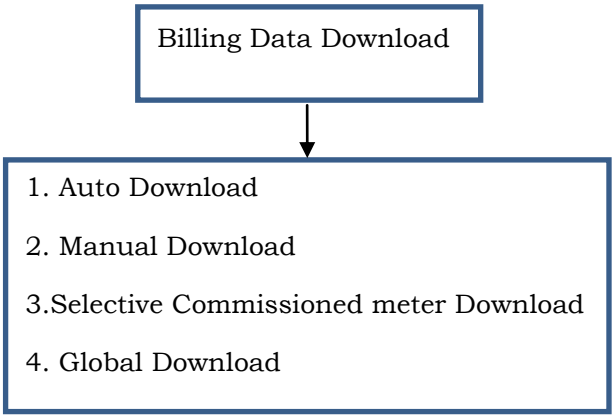
ANNEXURE - VII

COMMON MENU STRUCTURE FOR HHT APPLICATION

Menu of HHT APPLICATION



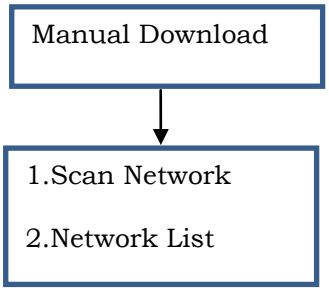
1)Billing Data Download Sub Menu -



NOTE :

- On Selection of options 1 i.e. “Auto Download”, HHT will scan for the PANs available and will download each PAN and thereafter Meters(if any) on global mode will be downloaded .

Manual Download Sub Menu

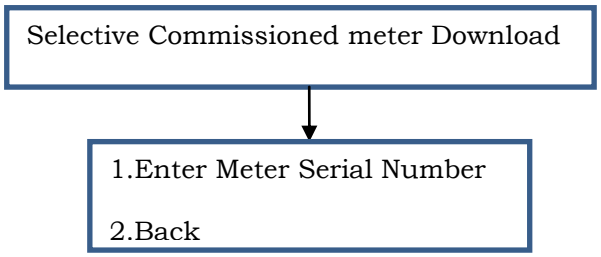


NOTE :

- On Selection Of Scan Network Menu HHT will scan for the PANs available , after completion of the scan list of available PANs will be displayed as PAN id and Coordinator serial number on the HHT screen User has to manually select the PAN to be Downloaded.

- On Selection Of Scan Network Menu the PANs available in job configured to HHT will be displayed as PAN id and Coordinator serial number on the HHT screen. User has to manually select the PAN to be Downloaded.

Selective Commissioned Meter Download



NOTE :

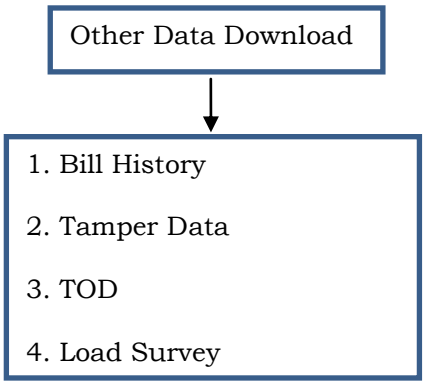
- User will enter the serial number of commissioned meter in the which is available in Job. The Billing Data of that meter will be downloaded.

Global Download Sub Menu

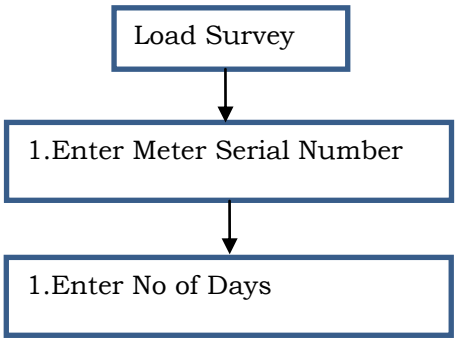
NOTE :

- On selecting Global Download Menu , HHT will scan all the meter in the surrounding which are on Global Mode and download only “Billing Data” for meters in global mode.

2) Other Data Download Sub Menu -



Load Survey Sub Menu

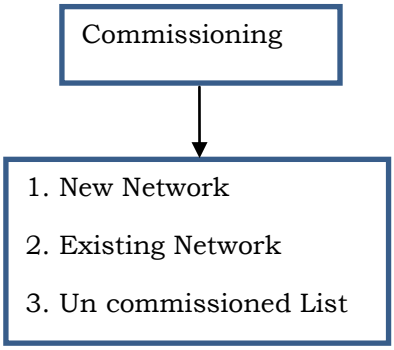


NOTE :

- After selecting load Survey Menu user will be prompted to enter the meter serial number after entering the meter serial number , it will again prompt for Number days for which Load Survey Data Needs to be downloaded.

- The range for number of days to be entered is 1 to 45 days.

3)Commissioning Sub Menu



NOTE :

- On selecting options 1 i.e. “New Network” , User will be prompted to enter serial numbers of the meters to be commissioned. New network will be formed with first meter number entered as a coordinator and user may enter the serial number of meters all at a time or one meter can be added after previous one is commissioned.

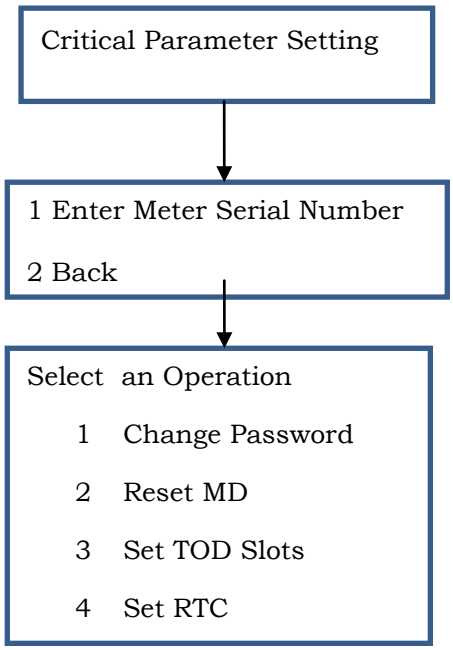
- On selecting option 2 i.e. “Existing Network” , the PAN available in the job configured to HHT will be displayed on the HHT screen user has to select the PAN . After selecting the PAN user will be prompted for the meter serial number to be commissioned. The meter will be added to the selected PAN as a router.

- On selecting option 3 i.e. “Un commissioned List” ,list of all the un commissioned meters in the job configured to HHT will be displayed.

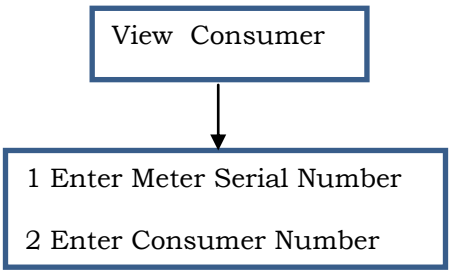
4) BCS Interface

- HHT will Display a message “BCS COMMONICATION…..”on screen.

6) Critical Parameter Setting Sub Menu



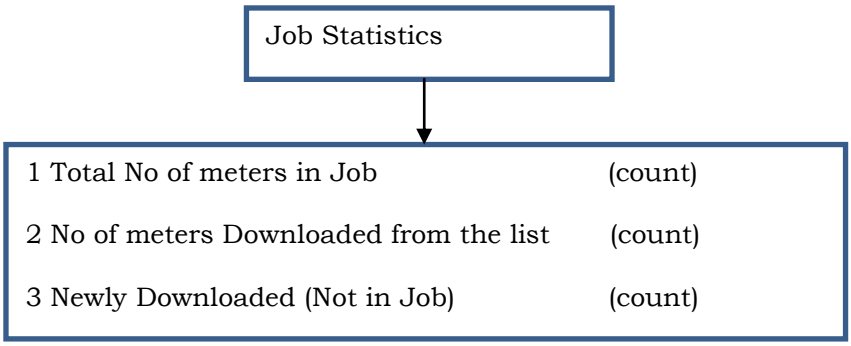
6)Consumer Details



NOTE :

- User will either select meter number or Consumer number. The consumer details will be displayed on the HHT screen Consumer Details include
    1. Consumer Number
    2. Consumer Name
    3. Consumer Address
    4. Meter Make Code
    5. Meter Serial Number
    6. Meter Download Status(Downloaded/ Not Downloaded)
    7. Billing Data(KWH value Downloaded)

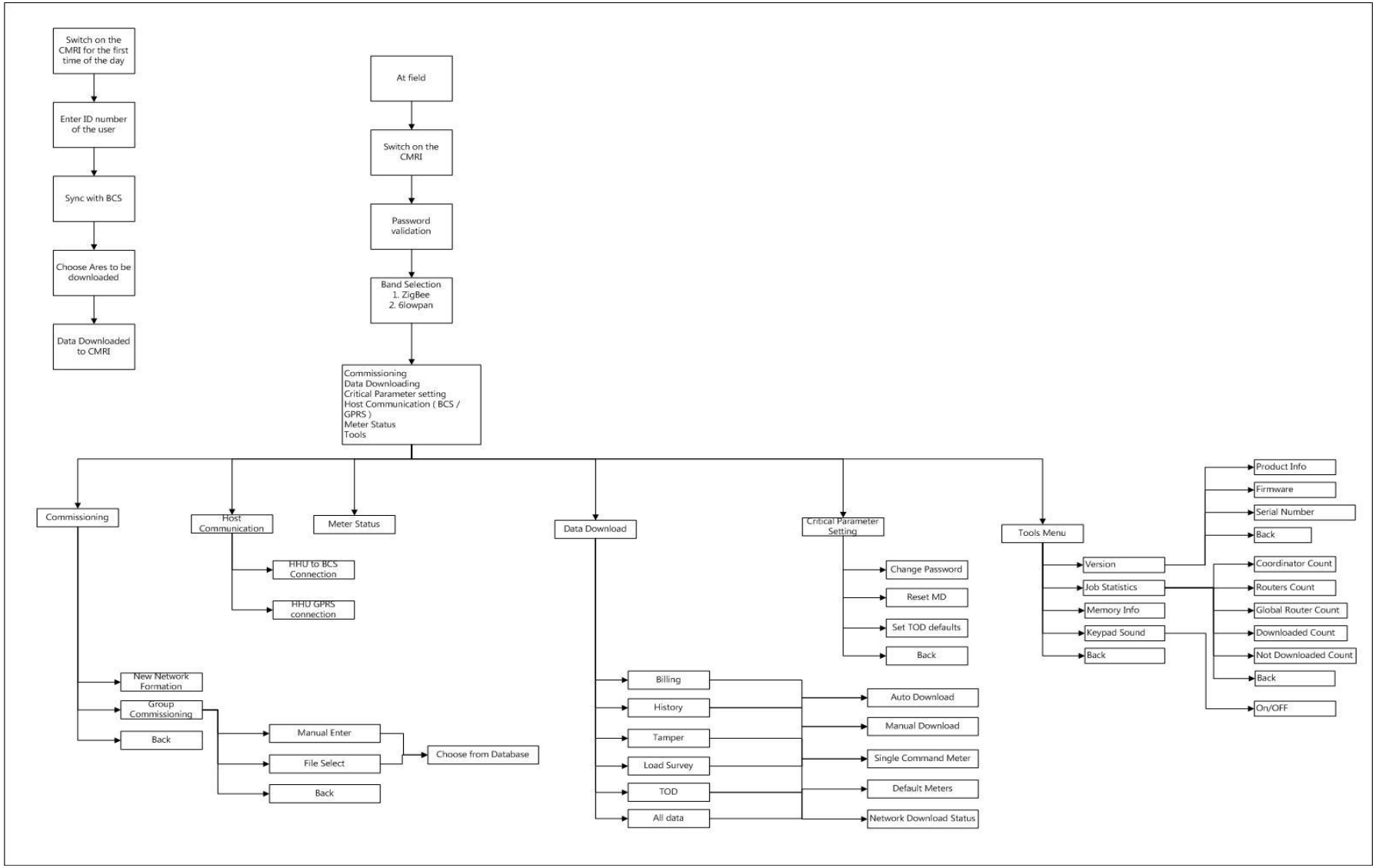
7) Job Statistics



NOTE :

Whenever user selects any options from 1 to 4. The corresponding meters serial numbers in that category will be displayed.

HHT Workflow for Data Download and Commissioning



ANNEXURE – VIII

Common File Saving Formats of HHT

The purpose of this document is to specify a common file saving format for data acquired in HHT through LPRF Port.

Total Number of Files required to be stored in HHT

1. Billing
2. Meter History kWH
3. Tampers
4. Load Survey
5. TOD Data
6. Meter_Consumer_details File.
7. Network Details for Meters File.
8. Job Details in HHT File

Filenames

Following are the file names for saving the above files in HHT.

1. BILL.MRI (For Billing file)
2. KWH.MRI (For Meter History kWH File)
3. TPR.MRI (For Tamper File)
4. LSD.MRI (For Load Survey File)
5. TOD.MRI (For TOD data)
6. RFMSTR.MRI (For Meter Consumer details File)
7. NETWORK.MRI (For Network Details of Meters in HHT)
8. JOB.MRI (For Job Details Stored in HHT)

HHT File Format for Meter Data

Note:-

- All data must be in format provided by MSEDCL.
- In meter data file, every meter data must start with new line.
- At the end of each meter data files suffix "Q" must be added.
- During downloading of Billing, Following Sequence for writing data shall be adhered:
    - Meter Serial Number
    - Make Code
    - Active Energy in kWH (current month)
    - MD (kW/kVA) (current month)
    - MD Date/time (current month)
    - Time (Meter RTC)
    - Date (Meter RTC)
    - Active Energy in kWH of previous month1
    - Active Energy in kWH of previous month2
    - Active Energy in kWH of previous month3
    - Active Energy in kWH of previous month4
    - Active Energy in kWH of previous month5
    - Active Energy in kWH of previous month6
    - MD(kW/kVA) of previous month1
    - MD Date/time of previous month1
    - MD(kW/kVA) of previous month2
    - MD Date/time of previous month2
    - MD(kW/kVA) of previous month3
    - MD Date/time of previous month3
    - MD(kW/kVA) of previous month4
    - MD Date/time of previous month4
    - MD(kW/kVA) of previous month5
    - MD Date/time of previous month5
    - MD(kW/kVA) of previous month6
    - MD Date/time of previous month6

  Note : In case of Single Phase meters MD values should be in kW and in case of Three Phase meters MD values should be in kVA

- During downloading of Tamper, Following Sequence for writing data shall be adhered:
    - Reverse Tamper
    - Earth Tamper
    - Neutral Missing Tamper

- Magnet Tamper
- Meter Cover Open Tamper
- EMI/EMC Field Tamper
- Missing PotentialTamper
- Potential Imbalance Tamper
- Current Unbalance Tamper
- Current reversal Tamper
- Current circuit short Tamper
- CT Bypass Tamper
- PowerON OFF Tamper

Tags

1. BIL For Billing Data
2. KWH For Only kWH Data
3. TAR For Reverse Tamper Data
4. TAE For Earth Tamper Data
5. TAN For Neutral missing Tamper Data
6. TAM For Magnet Tamper
7. TAS For EMI/EMC Field Tamper
8. TAC For Meter Cover Open Tamper
9. TAP For Missing Potential
10. TAT For Potential Unbalance
11. TAU For Current unbalance Tamper
12. TAV For Current reversal Tamper
13. TAX For current circuit short Tamper
14. TAY For CT Bypass Tamper
15. TAZ For Power On OFF
16. LSD For Load Survey Data
17. MTR For Meter Serial Number file
18. EN# End Of Data.
18. Q At the end of the file.
19. CPT For setting TOD timings through critical parameter setting.
20. NWK For Network related Entries
21. JOB For Job related entries
22. RFM For RF Meter related data.

Format of Billing File (BILL.MRI) :

TAG	Serial Number	Make Code	Meter Phase	Meter Type	Data	EN#

i.e

Tag BIL

<Serial Number>

<Make Code>

<Meter Phase>

Data

<kWH><MDkW/kVA><MD Time HH:MI><MD Date DD:MM:YY><Reading Time HH:MI><Reading Date DD:MM:YY><Meter RTC Time HH:MI><Meter RTC Date DD:MM:YY><Tamper present status><kVAh><kVArh (Lag)><kVArh (Lead)><Voltage V_{RN}><Voltage V_{YN}><Voltage V_{BN}><Current I_R><Current I_Y><Current I_B>

End of Data EN#

Note:

1. The meter Phase attribute should mention values as follows:

   1: Single Phase Meter

   3: Three Phase Meter

Example of billing data file (containing data of two meters).

BIL(00114214)(071)(3)(00011.4)(01.3)(00:30)(01:10:12)(10:19)(01:10:12)(10:19)(01:10:12)(00000000000000000000000000000101)(00011.3)(00001.0)(00001.0)(210)(230)(220)(5500)(5600)(4500) EN#

BIL(00114216)(056)(3)(00075.3)(02.7)(08:48)(01:10:12)(10:19)(01:10:12)(10:19)(01:10:12)(00000000000000000000000000000101)(00075.1)(00020.1)(00013.6)(210)(230)(220)(5500)(5600)(4500)EN#Q

Note : In case of Single Phase meters MD values should be in kW and in case of Three Phase meters MD values should be in kVA

Format of Meter History KWH File (KWH.MRI) :

TAG	Serial Number	Make Code	Data	EN#

i.e

Tag KWH

<Serial Number>

<Make Code>

Data

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA TimeHH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA Time HH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA Time HH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA Time HH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA Time HH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA Time HH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA Time HH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA Time HH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

<kWH><MDkW/kVA><MD kW/kVA Date DD:MM:YY><MD kW/kVA Time HH:MI><kVAh><rkVAh(Lag)><kVAh(Lead)>

End of Data EN#

Example of Meter History KWH data file (containing data of one meter).

KWH(00100869)(052)(000180.1)(04.5)(10:02:14)(13:10)(000179.2)(000179.3)(00181.9)

(00160.1)(03.5)(11:01:14)(12:10)(00160.4)(000162.9)(00159.2)

(00145.1)(05.50)(12:12:13)(12:15)(00144.9)(00144.7)00145.9)

(00120.3)(04.5)(11:11:13)(10:10)(00125.9)(00127.4)00126.4)

(00103.8)(05.3)(12:10:13)(09:15)(00101.9)(00103.1)(00102.1)

(00087.4)(03.4)(15:09:13)(10:50)(00086.3)(00086.3)(00088.1)

(00075.1)(04.5)(10:08:13)(13:10)(00074.1)(00074.9)(00075.2)

(00065.1)(03.5)(11:07:13)(12:10)(00063.7)(00064.9)(00065.9)

(00057.1)(05.50)(12:06:13)(12:15)(00054.2)(00056.6)(00058.7)

(00050.4)(04.5)(07:05:13)(10:10)(00047.9)(00047.4)(00049.3)

(00043.1)(05.3)(12:04:13)(09:15)(000041.9)(00041.8)(00044.1)

(00028.4)(03.4)(15:03:13)(10:50)(00027.3)(00026.3)(00027.1)

EN#Q

Note : In case of Single Phase meters MD values should be in kW and in case of Three Phase meters MD values should be in kVA.

Format of Tamper Data File (TPR.MRI) :

TAG	Serial Number	Make Code	Data	EN#

i.e

Tag (Any one of the following tag as per tamper event)

TAR For Reverse Tamper Data
TAE For Earth Tamper Data
TAN For Neutral Missing Tamper Data
TAM For Magnet Tamper
TAS For EMI/EMC Field Tamper
TAC For Meter Cover Open Tamper
TAP For Missing Potential
TAT For potential Unbalance
TAU For Current unbalance Tamper
TAV For Current reversal Tamper
TAX For current circuit short Tamper
TAY For CT Bypass Tamper
TAZ For Power On Off Tamper

<Serial Number>
<Make Code>

Data

<Event Number><Tamper Phase><Occurrence Date DD:MM:YY>

<Occurrence Time HH:MI>><Restoration Date DD:MM:YY>

<Restoration Time HH:MI>

End of Data EN#

Example of tamper data file (containing data of two meters)..

TAM(00100869)(001)(01,00,24:02:11,10:28,24:02:11,10:52)(02,00,24:02:11,10:22,24:02:11,10:25)(03,00,24:02:11,10:14,24:02:11,10:17)(04,00,24:02:11,10:07,24:02:11,10:11)(05,00,00:00:00,00:00,00:00:00,00:00)(06,00,00:00:00,00:00,00:00:00,00:00)(07,00,00:00:00,00:00,00:00:00,00:00)(08,00,00:00:00,00:00,00:00:00,00:00)(09,00,00:00:00,00:00,00:00:00,00:00)(10,00,00:00:00,00:00,00:00:00,00:00)EN#

TAP(00100869)(00101,02,24:02:11,10:28,24:02:11,10:52)(02,03,24:02:11,10:22,24:02:11,10:25)(03,01,24:02:11,10:14,24:02:11,10:17)(04,02,24:02:11,10:07,24:02:11,10:11)(05,00,00:00:00,00:00,00:00:00,00:00)(06,00,00:00:00,00:00,00:00:00,00:00)(07,00,00:00:00,00:00,00:00:00,00:00)(08,00,00:00:00,00:00,00:00:00,00:00)(09,00,00:00:00,00:00,00:00:00,00:00)(10,00,00:00:00,00:00,00:00:00,00:00)EN#

TAT(00100869)(001)(01,01,24:02:11,10:28,24:02:11,10:52)(02,02,24:02:11,10:22,24:02:11,10:25)(03,01,24:02:11,10:14,24:02:11,10:17)(04,03,24:02:11,10:07,24:02:11,10:11)(05,00,00:00:00,00:00,00:00:00,00:00)(06,00,00:00:00,00:00,00:00:00,00:00)(07,00,00:00:00,00:00,00:00:00,00:00)(08,00,00:00:00,00:00,00:00:00,00:00)(09,00,00:00:00,00:00,00:00:00,00:00)(10,00,00:00:00,00:00,00:00:00,00:00)EN#

TAC(00100870)(001)(00,27:01:11,15:05)EN#

TAV(00100869)(001)(01,01,24:02:11,10:28,24:02:11,10:52)(02,02,24:02:11,10:22,24:02:11,10:25)(03,01,24:02:11,10:14,24:02:11,10:17)(04,03,24:02:11,10:07,24:02:11,10:11)(05,00,00:00:00,00:00,00:00:00,00:00)(06,00,00:00:00,00:00,00:00:00,00:00)(07,00,00:00:00,00:00,00:00:00,00:00)(08,00,00:00:00,00:00,00:00:00,00:00)(09,00,00:00:00,00:00,00:00:00,00:00)(10,00,00:00:00,00:00,00:00:00,00:00)EN#Q

Format of Load Survey Data File (LSD.MRI) :

TAG	Serial Number	Make Code	Meter Phase	Data	EN#

i.e

Tag

LSD

<Serial Number><Make Code><Meter Phase>

Data <Load Profile Data >

End of Data EN#

Note:

In case of Single Phase RF meters Load Profile Data will consists of Interval Start Time, KWH, MD KW, Voltage and Current Parameters

In case of Three Phase RF meters Load Profile Data will consists of Interval Start Time, KWH, KVArh (Lag), KVArh (Lead), KVAh, $Voltage_{RN}$, $Voltage_{YN}$, $Voltage_{BN}$, Current R, Current Y, Current B Parameters.

Example of load survey data file for single phase RF meter (containing data of one meter)

LSD(00100869)(071)(01)((24:02:11 00:00,00.0,00.00,000,0000)

(24:02:11 00:30,00.0,00.00,000,0000)(24:02:11 01:00,00.0,00.00,000,0000)

(24:02:11 01:30,00.0,00.00,000,0000)(24:02:11 02:00,00.0,00.00,000,0000)

(24:02:11 02:30,00.0,00.00,000,0000)(24:02:11 03:00,00.0,00.00,000,0000)

(24:02:11 03:30,00.0,00.00,000,0000)(24:02:11 04:00,00.0,00.00,000,0000)

(24:02:11 04:30,00.0,00.00,000,0000)(24:02:11 05:00,00.0,00.00,000,0000)

(24:02:11 05:30,00.0,00.00,000,0000)(24:02:11 06:00,00.0,00.00,000,0000)

(24:02:11 06:30,00.0,00.00,000,0000)(24:02:11 07:00,00.0,00.00,000,0000)

(24:02:11 07:30,00.0,00.00,000,0000)(24:02:11 08:00,00.0,00.00,000,0000)

(24:02:11 08:30,00.0,00.00,000,0000)(24:02:11 09:00,00.0,00.00,000,0000)

(24:02:11 09:30,00.0,00.00,000,0000)(24:02:11 10:00,00.0,00.00,000,0000)

(24:02:11 10:30,00.0,00.00,000,0000)(24:02:11 11:00,00.0,00.00,000,0000)

(24:02:11 11:30,00.0,00.00,000,0000)(24:02:11 12:00,00.0,00.00,000,0000)

(24:02:11 12:30,00.0,00.00,000,0000)(24:02:11 13:00,00.0,00.00,000,0000)

(24:02:11 13:30,00.0,00.00,000,0000)(24:02:11 14:00,00.0,00.00,000,0000)

(24:02:11 14:30,00.0,00.00,000,0000)(24:02:11 15:00,00.0,00.00,000,0000)

(24:02:11 15:30,00.0,00.00,000,0000)(24:02:11 16:00,00.0,00.00,000,0000)

(24:02:11 16:30,00.0,00.00,000,0000)(24:02:11 17:00,00.0,00.00,000,0000)

(24:02:11 17:30,00.0,00.00,000,0000)(24:02:11 18:00,00.0,00.00,000,0000)

(24:02:11 18:30,00.0,00.00,000,0000)(24:02:11 19:00,00.0,00.00,000,0000)

(24:02:11 19:30,00.0,00.00,000,0000)(24:02:11 20:00,00.0,00.00,000,0000)

(24:02:11 20:30,00.0,00.00,000,0000)(24:02:11 21:00,00.0,00.00,000,0000)

(24:02:11 21:30,00.0,00.00,000,0000)(24:02:11 22:00,00.0,00.00,000,0000)

(24:02:11 22:30,00.0,00.00,000,0000)(24:02:11 23:00,00.0,00.00,000,0000)(24:02:11 23:30,00.0,00.00,000,0000))EN#Q

Example of load survey data file for Three phase RF meter (containing data of one meter)

LSD(00100869)(001)(03)((24:02:1100:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 00:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 01:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 01:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 02:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 02:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 03:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 03:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 04:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 04:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 05:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 05:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 06:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 06:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 07:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 07:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 08:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 08:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 09:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 09:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 10:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 10:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 11:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 11:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 12:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 12:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 13:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 13:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 14:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 14:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 15:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 15:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 16:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 16:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 17:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 17:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 18:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 18:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 19:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 19:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 20:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 20:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 21:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 21:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 22:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 22:30,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 23:00,0000,0000,0000,000,000,000,00000,00000,00000,00000)

(24:02:11 23:30,0000,0000,0000,000,000,000,00000,00000,00000,00000))EN#Q

Format of TOD Data File (TOD.MRI) :

TAG	Data	EN#

i.e

Tag TOD
Data
<Serial Number><Make Code><Meter Phase><Meter Type><Reading UTC Time>

<TZ1 KWH><TZ1 MD><TZ1 MD Timestamp><kVAh TZ1><kVArh(lead) TZ1><kVArh(lag) TZ1>

<TZ2 KWH><TZ2 MD><TZ2 MD Timestamp><kVAh TZ2><kVArh(lead) TZ2><kVArh(lag) TZ2>

<TZ3 KWH><TZ3 MD><TZ3 MD Timestamp><kVAh TZ3><kVArh(lead) TZ3><kVArh(lag) TZ3>

<TZ4 KWH><TZ4 MD><TZ4 MD Timestamp><kVAh TZ4><kVArh(lead) TZ4><kVArh(lag) TZ4>

End of Data EN#

Example of TOD data file (containing TOD data of One Consumers)

TOD(12346578)(001)(01)(0)(11:10:15 15:30)(135)(09.00)(10:10:15 2:30)(137)(130)(07.00)(10:10:15 14:00)(132)(115)(05.00)(10:10:15 10:00)(117)(120)(5.5)(10:10:15 20:30)(125)EN#Q

Format of Network Data File (NETWORK.MRI) :

For Zigbee

TAG	Data	EN#

i.e

Tag NWK
Data
<NetworkID><Co-ordinator Serial Number><Co-ordinator make code><Security Key><Network-Key><Ext-PAN> <Short-Pan><Channel><Channel Mask><Meter Count><Last Downloaded Timestamp>
End of Data EN#

For 6LoWPAN :

TAG	Data	EN#

i.e

Tag NWK
Data
<NetworkID><Root Serial Number><Root make Code><PANID><Channel><AES KEY><ipv6Prefix><Meter Count>EN#

End of Data EN#

Note:

1) The RF Module returns date in Hex format, but it shall be the responsibility of the HHT software/firmware to decode the date and store in proper date format of dd-MM-yyyy hh24:mi:ss
2) All values should be written in Big endian format only.

Example of Network data file (containing data of only one network)

NWK(0001)(10100389)(076)(052444140207894505244414020789 45)(E91A57C6D681517E2AA9C2D18BD536FF)(0524441402078945)(0)(0)(2105344)(4)(18:05:2015 14:32:12)EN#Q

Format of Meter Master Data File (RFMSTR.MRI) :

TAG	Serial Number	Make Code	Data	EN#

i.e

Tag MTR
Data
<Meter Sl No><Mk Code><Consumer number><Consumer name><Cons Address><Commission Status><Device Type> <Network ID><MAC Address><DL Status><CP New Password> <CP Old Password><CP RTC Flag><CP MD Reset flag><CP TOD Flag><CP TOD slot count><CP TOD Slots><CP MD time Flag><CP MD time value>
End of Data EN#

Note:

a) In case of flags the following convention is to be followed:

0: Forbidden to reset

1: Allowed to reset

2: Reset successful

3: Reset Failed

b) In case of CP TOD Slots, the slots separated by ':' represent the duration of the slots.

c) As the count of TOD slots is also mentioned, the TOD hour slots data will only be equal in number to the earlier mentioned value of TOD hour slots count.

d) In case of '0' count of TOD slots a null value bracket of TOD hour slots will be present.

e) After updating CP meter data viz., CP Password reset, CP MD Reset, etc. it shall be the responsibility of the HHT software/firmware to update the corresponding flags in the RFMSTR.MRI file according to conventions given in Note (a) under RFMSTR.MRI file specification heading.

f) All values should be written in Big endian format only.

Example of Meter Master data file (containing data of Two Consumers)

MTR(00000030)(082)(123456789123)(MSEDCL Sample Consumer1)(HOIT Prakashgad)
(1)(C)(0001)(00124B000000001E)(0)(00000030)(00000030)(0)(0)(1)(4)(6:6:6:6)(1)(1) EN#

MTR(00130704)(053)(123456789124)(MSEDCL Sample Consumer2)(HOIT Prakashgad)
(1)(R)(0001)(3CC1F6030001FE90)(0)(00130704)(00130704)(1)(1)(0)(0)()(0)() EN#Q

Format of Job Data File (JOB.MRI) :

TAG	Job ID	Job Date	Data	EN#

i.e

Tag JOB
Data
<JobID><Job Date><<Job Description><BU><Commission Allowed><Job Download Status>
End of Data EN#Q

Note:

a) The commission allowed flag indicates whether the HHT Operator is allowed to perform the activity of commissioning of meters in this job. The convention to be followed is as follows:

0: Not allowed to commission
1: Allowed to commission the available un-commissioned meters.

b) The job download status is as follows :
'0' : New Job (No readings/ meter data available in .MRI files)
'1' : Readings / Meter Data for at least any one meter is present in HHT.
'2' : Job in HHT is successfully downloaded to BCS. (Jobs in HHT can be downloaded to BCS multiple times)

Example of Job data file (containing data of One Job [Jobs are only one per HHT])

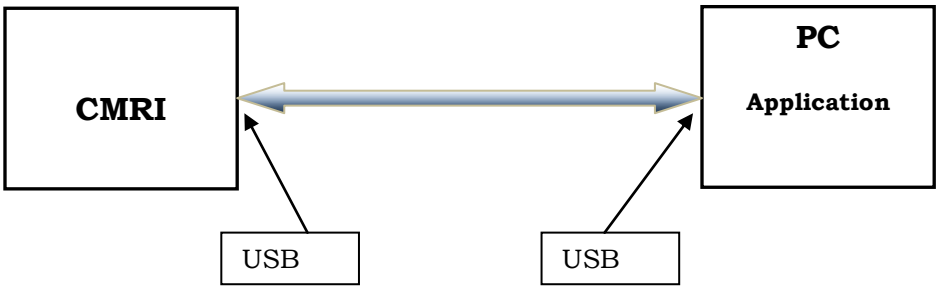
JOB(123456789)(16-May-2015)(Example Job)(9999)(1)(0)EN#Q

ANNEXURE - IX

File Transfer Protocol for Communication between HHT and BCS

File Transfer Process: USB

Connectivity Diagram



Pin Configuration for USB Data Cable of HHT

The data cable of HHT should be USB 2.0 Compliant. No other cable (viz. Serial, COM, etc.) shall be accepted.

The configuration for the USB is as follows:

Type A USB Pin for Computer / PC End of data cable

Type B (Mini/Micro) USB Pin for HHT End of Data Cable

Figure : USB Pin Configuration for Data Cable

The pin-out for the cable shall be as given in the table:

The USB Pinout:

Pin	Name	Cable color	Description
1	VCC	Red	+5 VDC
2	D-	White	Data -
3	D+	Green	Data +
4	GND	Black	Ground

Low Level Device Driver

PC needs device driver to detect when HHT connected for the first time. This is the Low Level Driver and need to be installed once in PC. This low level driver take care the communication and detection of HHT in Operating System. This will be provided by the Meter Manufacturer. Any configuration other than low driver installation like manual IP configuration to HHT, should not be required.

High Level Device Driver

High Level Device Driver needs to establish communication between Application and HHT. Meter manufacturer will provide the high level driver. This high level device driver shall be provided as a native DLL along with necessary wrappers for java, and all the header files and libraries and other dependencies, if any.

Implementation Hierarchy

High Level Device Driver

The following functionality shall be available in High Level Device Driver:-

1. A function which can Assign Job to HHT
2. A function which upload data from HHT
3. Set RTC of HHT
4. Get RTC of HHT
5. Can Clear Job from HHT
6. Can get the list of files in relevant location of HHT
7. Get the Serial Number of HHT

High Level Device Function Description

Sl No	Description	Function Name	Parameters	Return Parameters
1	Configure Job to HHT	ConfigureJobToHHT	• Data Type: String • Parameters 1. Job File name(i.e.JOB.MRI) : Full path name of JOB.MRI in PC to be sent to HHT 2. Network file Name: (i.e.NETWORK.MRI) Full path name of NETWORK.MRI in PC to be sent to HHT 3. Meter Details File Name (i.e. RFMSTR.MRI) Full path name of RFMSTR.MRI in PC to be sent to HHT	• Data Type:int • Values 1. Successful 2. PC File does not exist 3. Error in detecting USB 4. Others
2	Download Job From HHT	DownloadJobFromHHT	• Data Type: String • Parameters 1. Job File name(i.e.JOB.MRI) : Full path name of in PC where JOB.MRI to be received from HHT. 2. Network file Name (i.e.NETWORK.MRI): Full path name of in PC where NETWORK.MRI to be received from HHT. 3. Meter Details File Name (i.e. RFMSTR.MRI) : Full path name of in PC where RFMSTR.MRI to be received from HHT. 4. BILLING DATA File Name	• Data Type:int • Values 1. Sucessful 2. HHT File does not exist 3. Error in detecting USB 4. Others 5. File already exists in PC with same name

			(i.e. BILL.MRI) : Full path name of in PC where BILL.MRI to be received from HHT. 5. BILL HISTORY DATA File Name (i.e.KWH.MRI) : Full path name of in PC where KWH.MRI to be received from HHT. 6. TAMPER DATA File Name (i.e. TPR.MRI): Full path name of in PC where TPR.MRI to be received from HHT. 7. LOAD SURVEY DATA File Name (i.e. LSD.MRI): Full path name of in PC where LSD.MRI to be received from HHT. 8. TRANSACTION DATA File Name (i.e. TRANS.MRI): Full path name of in PC where TRANS.MRI to be received from HHT.	
3	Setting RTC of HHT	SetHHTRTC	DateValue : in DD/MM/YYYY HH:MM:SS	• Data Type:Boolean True - Successful False - Fail
4	Get RTC of HHT	GetHHTRTC		• DateValue : in DD/MM/YYYY HH:MM:SS Null - Fail
5	Clear HHT Data	ClearHHT		• Data Type:Boolean True - Successful False - Fail
6	List of Files	GetFileList	HHTFilename : Each time it will send a File to BCS	• Data Type: String - Files names separated with comma- successful

				- Empty – Fail -
7	Get Manufacturer Serial Number of HHT	GetHHTSlNo		• Data Type: String HHTSlNo : Serial Number of HHT • Empty- Fail

ANNEXURE – X

RF METERING PROTOCOL- FOR ZIGBEE BASED SINGLE PHASE & THREE PHASE RF METERS

Part I : MSEDCL Cluster

1.00 Scope and Purpose

This section specifies a single cluster, the Maharashtra State Electricity Distribution Company Limited (MSEDCL) cluster, which provides representation of data elements not found in the Zigbee Smart Energy Simple Metering Cluster. It is in intention that multiple meter manufactures intending to provide product for Indian state of Maharashtra support this cluster in its entirety.

This section should be used in conjunction with the Zigbee Cluster Library: Foundation Specification (see (R4)), which gives an overview of the library and specifies the frame formats and general commands used therein.

2.00 Introduction

This cluster facilitates the representation and exchange of data elements not found in the Zigbee Smart Energy Simple Metering Cluster for the Indian State of Maharashtra. These data elements are historic to the MSEDCL cluster supported by multiple meter manufacturers.

3.00 Server

3.01 Dependencies

None

3.02 Attributes

For convenience, the attributes defined in this specification are arranged into sets of related attributes; each set can contain multiple attributes. Attribute identifiers are encoded such that the most significant byte specifies the attributes set and the least significant byte specifies the attribute within the set. The currently defined attribute sets are listed in the table below.

Attribute Set Identifier	Description
0x00	Meter Information
0x01	Cumulative Active Energy

0x02	Maximum Demand (kW MD)
0x03	Tamper Information (Set1) for Single Phase & Three Phase Meters
0x04	Time zone wise Cumulative Active Energy
0x05	Time zone wise Maximum Demand
0x06	Load Profile
0x07	For 3 phase meter - power on/off events
0x08	Tamper Information (Set2)

3.02.01 Meter Information Attribute Set (0x00XX)

The attributes that are used in the Meter Information attribute Set are summarized in the below table.Some of these attributes overlap with functionality provided on the Basic cluster. Information presented by these attributes should be mirrored on the Basic cluster.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	Serial Number	Character string	8 bytes	Read only	M
0x01	Make code	Character string	5 bytes	Read only	M
0x02	Meter time	UTCTime	Unsigned 32 bit integer	Read only	M

3.02.01.1 Serial Number Attribute

This attribute is a character string representing the serial number of the meter.

3.02.01.2 Make Code Attribute

This attribute is a character string representing the make code of the meter.

3.02.01.3 Meter Time Attribute

This attribute returns the time currently seen in the meter.

3.02.01 Cumulative Active Energy Attribute Set (0x01XX)

This attributes that are used in the Cumulative Active Energy Attribute Ser are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory / Optional
0x00	Cumulative ActiveEnergy	Unsigned 32-bitinteger	0x00000000 – 0xffffffff	Read Only	M
0x01— 0x06	Cumulative ActiveEnergy of PreviousMonth 1 - 6	Unsigned 32-bitinteger	0x00000000 – 0xffffffff	Read Only	M

3.02.02.1 Cumulative Active Energy

These attributes give the current cumulative active energy value for the meter. The value is a fixed point value of 0.1 kWh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kWh.

3.02.02.2 Cumulative Active Energy of previous Months 1-6

These attributes give the historic consumption information for previous months. The value is a fixed point value of 0.1 kWh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kWh.

3.02.02 Maximum Demand Attribute set (0x02XX)

The attributes that are used in the Maximum Demand Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory/ Optional
0x00	Maximum	Unsigned	0x0000 –	Read	M

	Demand of Current Month	16-bit integer	0xffff	Only	
0x01	Maximum Demand of Current Month Timestamp	UTC Time		Read Only	M
0x02	Maximum Demand of previous Month 1	Unsigned 16-bit integer	0x0000 – 0xffff	Read Only	M
0x03	Maximum Demand of previous Month 1 Timestamp	UTC Time	0x0000 – 0xffff	Read Only	M
0x04	Maximum Demand of previous Month 2	Unsigned 16-bit integer	0x0000 – 0xffff	Read Only	M
0x05	Maximum Demand of previous Month 2 Timestamp	UTC Time	0x0000 – 0xffff	Read Only	M
0x06	Maximum Demand of previous Month 3	Unsigned 16-bit integer	0x0000 – 0xffff	Read Only	M
0x07	Maximum Demand of previous month 3 Timestamp	UTC Time	0x0000 – 0xffff	Read Only	M
0x08	Maximum Demand of	Unsigned 16-bit	0x0000 –	Read Only	M

	previous Month 4	integer	0xffff		
0x09	Maximum Demand of Previous Month 4 Timestamp	UTC Time	0x0000 – 0xffff	Read Only	M
0x0a	Maximum Demand of Current Month 5	Unsigned 16-bit integer	0x0000 – 0xffff	Read Only	M
0x0b	Maximum Demand of previous Month 5 Timestamp	UTC Time	0x0000 – 0xffff	Read Only	M
0x0c	Maximum Demand of previous Month 6	Unsigned 16-bit integer	0x0000 – 0xffff	Read Only	M
0x0d	Maximum Demand of previous month 6 Timestamp	UTC Time	0x0000 – 0xffff	Read Only	M

Note : For Single Phase Meter : Maximum Demand shall be in kW MD

For Three Phase Meter : Maximum Demand shall be in kVA MD.

3.02.03.1 **Maximum Demand of Current Month**

This attributes give the maximum demand for the current month. The value is a fixed point value of 0.1 kW or 0.1 kVA encoded as an unsigned 16-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kW or kVA. Invalid values are given as 0xffff.

3.02.03.2 **Maximum Demand of current Month Timestamp**

These attributes give a timestamp for when the maximum demand of the current month occurred. An invalid value is given as 0xffffffff.

3.02.03.3 **Maximum Demand of Previous Months 1-6**

These attributes give the historic maximum demand information for previous months. The value is a fixed value of 0.1 kW or 0.1 kVA encoded as an unsigned 16-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kW or kVA. Invalid values are given as 0xffff.

3.02.03.4 **Maximum Demand of previous Months Timestamp 1-6**

These attributes give the timestamp for when the historic maximum demand occurred for previous months. An invalid value is given as 0xffffffff.

3.02.03 **Tamper Information Attribute Set1 (0x03XX)**

The attributes of Single Phase RF meter, that are used in the Tamper Attribute Set1 are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory /Optional
0x00-0x09 0x10-0x19	Latest 10 Tamper Events – Reversal Phase and Neutral and Reversal of Line And Load Start (0x0X) and Stop (0x1X) times	UTC Time		ReadOnly	M
0x0a-0x0f 0x1a-0x1f	Reserved				
0x20-0x29 0x30-0x39	Latest 10 Tamper Events-Load Through Local Earth Start (0x2x) and Stop (0x3X) times	UTC Time		ReadOnly	M
0x2a-0x2f 0x3a-0x3f	Reserved				

0x40-0x49 0x50-0x59	Latest 10 Tamper Events – Neutral Disconnected Start (0x04X) and Stop (0x5X) times	UTC Time		ReadOnly	M
0x4a-0x4f 0x5a-0x5f	Reserved				
0x60-0x69 0x70-0x79	Latest 10 Tamper Events Magnetic Tamper Start (0x6X) and Stop (0x7X) times	UTC Time		ReadOnly	M
0x6a-0x6f 0x7a-0x7f	Reserved				
0x80	Meter Cover Open	UTC Time		ReadOnly	M

The attributes of Three Phase RF meter, that are used in the Tamper Attribute Set1 are summarized in the below table.

Identifier	**Name**	**Type**	**Range**	**Access**	**Mandatory / Optional**
0x00 – 0x09 0x10 – 0x19	Latest 10 Tamper Events – Missing Potential Start (0x0x) and Stop (0x1x) times	UTC Time	4 bytes	ReadOnly	M
0x0a – 0x0F 0x1a – 0x1f	Reserved				
0x20 – 0x29	Latest 10 tamper Events – Current	UTC Time	4 bytes	ReadOnly	M

0x30 – 0x39	Imbalance Start (0x2x) and Stop (0x3x) times				
0x2a – 0x2f 0x3a – 0x3f	Reserved				
0x40 – 0x49 0x50 – 0x59	Latest 10 Tamper Events – Current Reversal Start (0x4x) and Stop (0x5x) times	UTC Time	4 bytes	ReadOnly	M
0x4a – 0x4f 0x5a – 0x5f	Reserved				
0x60 - 0x69 0x70 – 0x79	Latest 10 tamper events – Current Short circuit Start (0x6x) and Stop (0x7x) times	UTC Time	4 bytes	ReadOnly	M
0x6a – 0x6f 0x7a – 0x7f	Reserved				
0x80	Meter Cover Open	UTC Time	4 bytes	ReadOnly	M
0x90 – 0x99 0xa0 – 0xa9	Latest 10 Tamper events – High Neutral Current Start (0x9x) and Stop (0xax) times	UTC Time	4 bytes	ReadOnly	M

0x9a – 9f 0xaa – 0xaf	Reserved				
0xb0 – 0xb9 0xc0 – 0xc9	Latest 10 Tamper events – Potential imbalance Start (0xbx) and Stop (0xcx) times	UTC Time	4 bytes	ReadOnly	M
0xba – 0xbf 0xca – 0xcf	Reserved				
0xd0 – 0xd9 0xe0 – 0xe9	Latest 10 Tamper events – Magnetic Tamper Start (0xdx) and Stop (0xex) times	UTC Time	4 bytes	ReadOnly	M
0xda – 0xdf 0xea – 0xef	Reserved				

3.02.04.1 **Latest 10 Tamper Event Attributes**

These attributes represents tamper events on the meter. There are 10 events for each event type. Each incrementing attributes index corresponds to one event further in the past. The beginning of an event is stored on one attribute (x), the end of the event is stored in attribute (x+0x0010). An invalid event is encoded as 0xffffffff.

3.02.04.2 **Meter Cover Open**

This attribute shall return timestamp for the last time the meter cover was opened. An invalid event is encoded as 0xffffffff.

3.02.04 **Tamper Information Attribute Set2 (0x08XX)**

The attributes that are used in the Tamper Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory /Optional
0x00-0x09 0x10-0x19	Latest 10 Tamper Events – ESD Tamper Start (0x0X) and Stop (0x1X) times	UTC Time	4 bytes	ReadOnly	M

This attribute represents ESD tamper events on the meter.

3.02.06 Time Zone wise Active Energy Attributes Set (0x04XX)

The attributes that are used in the Time Zone wise Active Energy Attribute Ser are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory /Optional
0x00	TZ1 Active Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	ReadOnly	M
0x01	TZ2 Active Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	ReadOnly	M
0x02	TZ3 Active Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	ReadOnly	M
0x03	TZ4 Active Energy	Unsigned 32- bit integer	0x00000000 -0xffffffff	ReadOnly	M

3.02.06.01 Time zone wise Active Energy

These attributes give the time zone wise current cumulative active energy value for the meter. The value is a fixed point value of 0.1 kWh encoded as an unsigned 32-bit integer. It should be divided by 10 in order to convert from the unsigned integer representation to the true decimal value in kWh.

3.02.07 Time Zone wise Maximum Demand Attribute Set (0x05XX)

The attribute that are used in the Time zone wise Maximum Demand Attribute Set are summarized in the below table.

Identifier	Name	Type	Range	Access	Mandatory /Optional
0x00	TZ1 Maximum Demand	Unsigned 16-bit integer	0x0000-0xffff	Read Only	M
0x01	TZ1 Maximum Demand Timestamp	UTC Time	0x0000-0xffff	Read Only	M
0x02	TZ2 Maximum Demand	Unsigned 16-bit integer	0x0000-0xffff	Read Only	M
0x03	TZ2 Maximum Demand Timestamp	UTC Time	0x0000-0xffff	Read Only	M
0x04	TZ3 Maximum Demand	Unsigned 16-bit integer	0x0000-0xffff	Read Only	M
0x05	TZ3 Maximum Demand Timestamp	UTC Time	0x0000-0xffff	Read Only	M
0x06	TZ4 Maximum Demand	Unsigned 16-bit integer	0x0000-0xffff	Read Only	M
0x07	TZ4 Maximum Demand Timestamp	UTC Time	0x0000-0xffff	Read Only	M

Note : For Single Phase Meter : Maximum Demand shall be in kW MD

For Three Phase Meter : Maximum Demand shall be in kVA MD.

3.02.07.01 **Time zone wise Maximum Demand**

This attributes give the time zone wise maximum demand for the current month. The value is a fixed point value of 0.1kW or 01.kVA encoded as an unsigned 16- bit integer. It should be divided by 10 in order to convert from the unsigned integration representation to the true decimal value in kW or kVA. Invalid values are given as 0xffff.

3.02.07.02 **Time zone wise Maximum Demand Timestamp**

These attributes give a timestamp for when the maximum demand of the corresponding time zone occurred. An Invalid value is given as 0xffffffff

3.02.08 **Load Profile Attribute Set (0x06XX)**

Attribute Set ID 0x06, attribute ID 0x00 will be used to retrieve this data with the most recent interval value being accessed with an index of 0, with an increasing value going into previous intervals.

Load profile shall be maintained for the previous 45 days on a power on basis. The values shall be integrated for 30 Minutes.

3.02.08.01 **Load Profile parameters for Single Phase RF meters**

Identifier	Name	Type	Range	Access	Mandatory / Optional
The 0x00	Load Survey	Set	22 bytes	Read Only	M

Thirty minute record will be maintained as a record consisting of the following fields.

Field name	Type
Interval start time	UTC time
kWh	Unsigned 32 bit integer
kW MD	Unsigned 16 bit integer
Voltage	Unsigned 16 bit integer
Current	Unsigned 16 bit integer

Note :

1. The voltage value will be the measured voltage with no decimal values.

2. The current will be in multiples of 10mA.For example, 1.54A will be represented as 154

60A will be represented as 6000

3.02.09 **Power On/OFF events Attribute set (0x07XX)**

(For Three Phase RF Meters Only)

Identifier	Name	Type	Range	Access	Mandatory / Optional

0x00 – 0xff	*Power OFF /On events - Timestamp*	UTC Time	4 bytes	ReadOnly	M

Note : First 50 events shall be for Power Off & next 50 events shall be for Power On.

Setting Critical Parameters

The purpose of this document is to specify a protocol sequence for certain operations.

These operations involve setting critical parameters in the meters.

1) Change the password in the meter
2) Reset of Maximum Demand.
3) Set the number of TOD slots and their durations.
4) Set meter time (RTC).

For the aforementioned purposes, the following parameters and protocol sequences are specified.

The cluster ID used for this purpose will be 0xfc01. This cluster shall be called MSEDCL CONTROL cluster. The application end point to be used is 1. The protocol sequence shall use the write attributes command of ZigBee cluster library. The commands involve use of multiple write attributes.

Protocol Sequences.

1) Change of password in the meter.

The default password in the meter shall be the meter's serial number. The following packets shall be sent from the CMRI to the meter.

Packet 1:

Attribute ID: 0x0000

Attribute type: String type

Attribute length: 6 – 20 bytes

Description: Old password.

Attribute ID: 0x0001

Attribute type: string type

Attribute length: 6 – 20 bytes

Description: New password.

Packet 2:

To be issued within 120 seconds of Packet 1:

Attribute ID: 0x0002

Attribute type: string type

Attribute length: 6 – 20 bytes

Description: New Password Reconfirm.

The CMRI software should have front end display capability to take the necessary inputs, give prompts to users.

Automatic extensions, forms, saves etc should not be implemented in CMRI.

The meter shall reset the password on successful completion of sequence. If the reconfirm packet is not received in the timeout provided, the new password will be discarded and the old one retained. If the old password does not match, the password will not be changed.

2) Protocol sequence for reset MD.

Packet 1:

Attribute ID: 0x0001

Attribute type: string type

Attribute length: 6 – 20 bytes

Description: Password.

Attribute ID: 0x0004

Attribute type: No data type

3) Protocol sequence for TOD timeslot setting

Packet 1:

Attribute ID: 0x0001

Attribute type: string type

Attribute length: 6 – 20 bytes

Description: Password.

Attribute ID: 0x0005

Attribute type: Variable length array.

Attribute Description: The 0th element will be a 16 bit element consisting of the length of the array and the following elements will be of 8 bit unsigned integer type.

The number in the 0th element lists the number of time of day (TOD) slots. The following array elements will describe the number of hours in each slot.

4) Protocol sequence for setting time in the meter.

Packet 1:

Attribute ID: 0x0001

Attribute type: string type

Attribute length: 6 – 20 bytes

Description: password.

Attribute ID: 0x0006

Attribute type: UTCTime.

Description: This command will set the RTC time in the meter.

ANNEXURE - XI

Draft Testing Template

Following parameters will be verified in the communication testing laboratory of IT Department.

Test Parameter	Test Result / Observations
Manual	
1. BCS Installation Manual (Yes/No)	
2. BCS Operational Manual (Yes/No)	
3. HHU Software Operational Manual (Yes/No)	
4. HHU Software Update Manual (Yes/No)	
5. Meter Technical Manual (Yes/No)	
6. HHU Technical Manual (Yes/No)	
Meter	
7. Make Code and Meter Serial Number	
8. Meter Phase (1 Ph / 3 Ph)	
9. TOD Meter (Yes / No)	
10. Meter RTC maintain time as per IST (Yes / No)	
11. PAN ID in Global Mode	
12. Link Key in Global Mode	
13. Communication Display on meter (Yes/No)	
14. Meter status on meter display such as: Router/Edge Router	
15. Details of RF module in meter a. RF Module Vendor Name & ID b. IEEE Address of RF Module c. Chipset of RF Module	
16. Module Certification	
17. MSEDCL RF Protocol (as given in Tender document) is implemented in Meter (Yes / No)	
Further testing will be done only if meter is as per MSEDCL RF protocol	
18. Interoperability with different HHU (Yes/No)	

Test Parameter	Test Result / Observations
BCS	
19. Operating System Version supported	
20. BCS User Name	
21. BCS Password	
22. Database	
23. BCS Software Version and display available in BCS	

(Yes/No)	
24. BCS Database is Password Protected (Yes/No)	
25. Importing Consumer Master xls file to BCS (Yes/No)	
26. Number of consumers data loaded in BCS	
27. Exporting Consumer Meter details from BCS to HHU (Yes/No)	
28. HHU data downloaded in BCS (Yes/No)	
29. Bill string file generated as per MSEDCL format a. Bill string for 1ph Meters (Yes/No) b. Bill string for 3ph Meters (TOD format) (Yes/No) c. Control Total generated (Yes/No)	
30. PAN Management (Manual / Auto)	
31. Reports available through BCS *	
A. Commissioning Report (Yes/No)	
B. Meter Reading downloaded Statistics (Yes/No)	
C. RTC Corrupted Report (Yes/No)	
D. Consumer wise Tamper Report (Yes/No)	
E. Consumer wise Load Survey Report (Yes/No)	
F. Consumer wise TOD Report (Yes/No)	
G. PAN wise coordinator and router Report (Yes/No)	
32. Facility for Backup and Restoration of Database (Yes/No)	
33. Option for clearing the HHU data in HHU (Yes/No)	
34. Security while data transfer between HHU and BCS (Yes/No)	

Test Parameter	**Test Result / Observations**
HHU	
35. HHU Serial Number	
36. HHU Make and model	
37. HHU Processor/Microcontroller Family	
38. RF Module to HHU is Internal (Yes/No)	
39. HHU supports dual band operations i.e. Zigbee operations 2.4 GHz and 6LoWPAN operations on 865-867MHz (Yes/No)	
40. HHU RF Module Details a. Make & Name of RF Module b. RF Module IEEE Address	
41. MSEDCL RF Protocol (as given in latest Tender document) is implemented in HHU (Yes / No)	
42. Ports available on HHU (COM / USB etc.)	
43. Communication cable for HHU and PC (COM / USB Cable)	
44. Memory Capacity of HHU (MB)	
45. Maximum time for which HHU waits to receive response from meter, before retrying the same command (In milliseconds)	

46. Type and make of batteries present in HHU	
47. Hours of operations if batteries are fully charged	
48. Battery status is indicated in the form of bar-graph in HHU display (Yes/No)	
49. Low battery indication provided (Yes/No)	
50. Automatic cut-off time if HHU is not in operation	
51. Details of Type Tests	
52. HHU Operating System	
53. HHU Firmware / Kernel Version	
54. Details of database implemented in HHU	
55. HHU Password Protected (If Yes, Mention password)	
56. HHU Software Version and display available on HHU (Yes / No)	
57. Program starts automatically after power on (Yes/No)	
58. Maximum Number of consumers data loaded in HHU	
59. Consumer details like number, name and address available in HHU data (Yes/No)	
60. Modes of commissioning available in HHU a. Auto (Yes / No) b. Manual (Yes / No)	
61. Commissioning attributes sent by HHU while commissioning of meters (for Zigbee) a. Preconfigured Link Key (Yes / No) b. Channel Mask (Yes / No) c. Startup Control (Yes / No) d. Extended PAN ID (Yes / No)	
62. Commissioning attributes sent by HHU while commissioning of meters (for 6LoWPAN) a. PAN ID (Yes / No) b. Channel (Yes / No) c. Device Type (Yes / No) d. IPv6 Prefix (Yes / No) e. AES Key (Yes / No) f. Commission state (Yes / No) g. DAG ID (Yes / No) h. Router List (Yes / No)	
63. Indication of HHU after successful downloading of any data from meter (e.g. Sound beep or message on HHU screen)	
64. Data stored in HHU is according to HHU common file format declared by MSEDCL a. BILL.MRI – For Billing Data (Yes/No) b. KWH.MRI- For Bill History (Yes/No) c. TPR.MRI- For Tamper Data (Yes/No)	

d. LSD.MRI – For Load Survey Data (Yes/No)	
65. HHU is having common menu structure declared by MSEDCL (Yes/No)	
66. Statistics of commissioning / readings downloaded in HHU a. Total meters uploaded in HHU for reading (Yes/No) b. Total meter reading downloaded in HHU (excluding the new meters) (Yes/No) c. No. of New meter reading downloaded in HHU (Yes/No) d. No. of Meters not downloaded in HHU (Yes/No)	
67. Settings of Critical Parameters like a. Change the password in the meter (Yes / No) b. Reset of Maximum Demand (Yes / No) c. Set the number of TOD slots and their durations (Yes / No) d. Set meter time (RTC) (Yes / No)	
68. Interoperability with different make of meters in setting of critical parameters (Yes/No)	
69. Data download options available in HHU a. Billing data (Yes/No) b. Billing History (Yes/No) c. Tampers (Yes/No) d. Load Survey (Yes/No) e. TOD (Yes/No) f. All Data (Yes/No)	
70. HHU download tamper present status along with billing data (Yes/No)	
71. HHU download tamper data according to tamper present status along with billing data (Yes/No)	
72. Time (in seconds) required to capture Billing Data without tamper present status from Meter	
73. Time (in seconds) required to capture Billing Data along with tamper present status from Meter	
74. Total time (in seconds) required to download the complete data	
75. Average time required to commission a single meter (in sec.)	
76. Interoperability with different makes of Meters (Yes/No)	
77. If Yes, List of meter make used for interoperability.	

78. Facility to update HHU software (Yes / No)	
79. HHU software updation is password protected (Yes/No)	
80. HHU is having in-built GSM/GPRS Modem (Yes/No)	

*** High Level Device Driver & GPRS functionality will be tested after testing of above parameters.***

Overall Remark :

SCHEDULE 'A'

GUARANTEED TECHNICAL PARAMETERS

SR. NO.	PARAMETERS	GTP VALUES
1.0	MANUFACTURER'S / SUPPLIER'S NAME AND ADDRESS WITH WORKS ADDRESS	TEXT
2.0	MAKE & TYPE	TEXT
3.0	APPLICABLE STANDARD	TEXT
4.0	METER BEARS ISI MARK (YES/NO)	BOOLEAN
5.0	ACCURACY CLASS 1.00 (YES/NO)	BOOLEAN
6.0	RATED VOLTAGE RANGE	TEXT
7.0	RATED VOLTAGE	TEXT
8.0	RATED BASIC CURRENT Ib	TEXT
9.0	MAXIMUM CURRENT	TEXT
10.0	STARTING CURRENT	TEXT
11.0	FREQUENCY RANGE	TEXT
12.0	POWER SUPPLY IS SMPS (YES/NO)	BOOLEAN
13.0	POWER FACTOR ZERO TO UNITY (ALL LAG OR LEAD) (YES/NO)	
14.0	STANDARD REFERENCE TEMPERATURE FOR PERFORMANCE IS 27^{O}C (YES/NO)	
15.0	MEAN TEMPERATURE CO-EFFICIENT DOES NOT EXCEED 0.07% (YES/NO)	
16.0	TEMPERATURE RISE IS AS PER IS: 13779 / 1999 (AMENDED UP TO DATE) (YES/NO)	
17.0	OPAQUE METER BASE & TRANSPARENT TOP COVER MADE OF UNBREAKABLE, TOUGH, HIGH GRADE, FIRE RESISTANT POLYCARBONATE MATERIAL (YES/NO)	

18.0	METER BODY TYPE TESTED FOR IP 51 DEGREE OF PROTECTION AS PER IS 12063 (YES/NO)	
19.0	MOULDED TERMINAL BLOCK CONFORMS TO IS: 13779 / 1999 (AMENDED UP TO DATE) (YES/NO)	
20.0	EXTENDED TRANSPARENT TERMINAL COVER AS PER CLAUSE NUMBER 6.5.2 OF IS: 13779 / 1999 (AMENDED UP TO DATE) IS PROVIDED (YES/NO)	
21.0	TRANSPARENT TERMINAL COVER IS SEALABLE INDEPENDENTLY (YES/NO)	
22.0	PROPER SIZES OF GROOVES ARE PROVIDED AT BOTTOM OF TERMINAL COVER (YES/NO)	
23.0	METER BASE & COVER ARE ULTRA-SONICALLY WELDED (CONTINUOUS WELDING) (YES/NO)	
24.0	THICKNESS OF MATERIAL FOR METER 2 MM MINIMUM (YES/NO)	
25.0	RTC PRE-PROGRAMMED FOR 30 YEARS DAY / DATE (YES/NO)	
26.0	TIME ACCURACY OF RTC AS PER CBIP TECH REPORT 88 (YES/NO)	
27.0	PROVISION TO PUT AT LEAST TWO SEALS BY UTILITY USER (YES/NO)	
28.0	COMPLETE METERING SYSTEM & MEASUREMENT NOT AFFECTED BY EXTERNAL ELECTROMAGNETIC INTERFERENCE AS PER CL. NO. 6.16 OF TECH. SPECS. (YES/NO)	
29.0	METER ACCURACY NOT AFFECTED BY AC / DC MAGNETIC FIELD UPTO 0.2 TESLA (YES/NO).	
30.0	METER ACCURACY DOES NOT GET INFLUENCED BY INJECTION OF HIGH FREQUENCY AC VOLTAGE / CHOPPED SIGNAL / DC SIGNAL AND HARMONICS ON THE TERMINALS OF THE METER (YES/NO)	

31.0	METER RECORDS AND DISPLAYS TOTAL ENERGY INCLUDING HARMONIC ENERGY.	
32.0	METER DISPLAYS UNSATISFACTORY FUNCTIONING OR NONFUNCTIONING OF REAL TIME CLOCK BATTERY (YES/NO)	
33.0	METER PCB IS WIRELESS (YES/NO)	
34.0	BATTERY BACK UP WITH MINIMUM 10 YEARS LIFE IS PROVIDED (YES/NO)	
35.0	METER WITHSTANDS PHASE TO PHASE VOLTAGE (440 V) IF APPLIED BETWEEN PHASE TO NEUTRAL FOR MINIMUM 5 MIN (YES/NO)	
36.0	POWER SUPPLY UNIT IS TRANSFORMER LESS (YES/NO)	
37.0	PUSH BUTTON PROVIDED FOR SCROLLING THE PARAMETERS IN ALTERNATE DISPLAY (ON DEMAND) MODE (YES/NO)	
38.0	OPERATION INDICATOR PROVIDED IN THE FORM OF BLINKING LED / LCD (YES/NO)	
39.0	METER CONSTANT INDELIBLY PROVIDED ON THE NAMEPLATE (YES/NO)	
40.0	METER MANUFACTURED USING SMT (YES/NO)	
41.0	TOD TIME ZONES PROVIDED (YES/NO)	
42.0	ALL ANTI-TAMPER FEATURES AS PER CLAUSE 10.00 ARE PROVIDED (YES/NO)	
43.0	UNDER INFLUENCE OF ANY MAGNETIC FIELD ABOVE 0.2 TESLA, IF THE ERRORS ARE BEYOND PERMISSIBLE LIMITS, METER RECORDS ENERGY CONSIDERING IMAX AND REFERENCE VOLTAGE AT UNITY POWER FACTOR (YES/NO)	
44.0	LCD CHECK IS PROVIDED TO DISPLAY HEALTHINESS OF ALL SEGMENTS (YES/NO)	BOOLEAN
45.0	BACKLIT LCD TYPE DISPLAY IS PROVIDED (YES/NO)	BOOLEAN
46.0	NUMBER OF DIGITS FOR ENERGY DISPLAY PROVIDED	TEXT

47.0	MINIMUM SIZE OF DIGITS	TEXT
48.0	DISPLAY PARAMETERS PREPROGRAMMED AT FACTORY AS PER CL. 12.00	BOOLEAN
49.0	PERIOD FOR AUTO SCROLL IS 9 SEC.	BOOLEAN
50.0	POWER CONSUMPTION IN VOLTAGE CIRCUIT	TEXT
51.0	POWER CONSUMPTION IN CURRENT CIRCUIT	TEXT
52.0	CONVENTIONAL TRANSFORMER LESS POWER SUPPLY IS PROVIDED (YES/NO)	BOOLEAN
53.0	PUSH BUTTON IS PROVIDED FOR HIGH RESOLUTION READINGS OF DISPLAY WITH TWO DECIMAL POINTS (YES/NO)	BOOLEAN
54.0	PUSH BUTTON ARRANGEMENT FOR ACTIVATION OF BATTERY IS PROVIDED (YES/NO)	BOOLEAN
55.0	KVAMD PROVIDED (YES/NO)	BOOLEAN
56.0	INTEGRATION PERIOD OF KVAMD	TEXT
57.0	COMMUNICATION CAPABILITY AS PER CL. NO. 6.23 OF SPECIFICATION (YES/NO)	BOOLEAN
58.0	MAKE OF 6LOWPAN RF MODULE USED IN METER	TEXT
59.0	MAKE OF 6LOWPAN AND ZIGBEE RF MODULE USED IN HHT	TEXT
60.0	ZIGBEE COMPLIANCE CERTIFICATE FOR RADIO MODULES USED IN METER & HHT IS SUBMITTED (YES/NO)	BOOLEAN
61.0	ZIGBEE COMPLIANCE CERTIFICATE NUMBER & DATE FOR RADIO MODULES	TEXT
62.0	CERTIFICATE OF PICS (PROTOCOL IMPLEMENTATION & CONFORMANCE STATEMENT) IN REGARDS MANUFACTURER SPECIFIC CLUSTER FROM ZIGBEE ALLIANCE OFFICIAL TEST HOUSE IS SUBMITTED. (YES/NO)	BOOLEAN

63.0	PICS CERTIFICATE NO. & DATE IN REGARDS MANUFACTURER SPECIFIC CLUSTER FROM ZIGBEE ALLIANCE OFFICIAL TEST HOUSE.	TEXT
64.0	COMPUTER SOFTWARE AS PER CLAUSE 15.00 OF TECHNICAL SPECIFICATION IS PROVIDED (YES/NO)	BOOLEAN
65.0	BASE COMPUTER SOFTWARE PROVIDED IS USER FRIENDLY & WINDOWS BASED & SUPPORTS ALL VERSIONS OF “WINDOWS”. (YES/NO)	BOOLEAN
66.0	BCS SUPPORTS ALL CURRENT OPERATING SYSTEM VERSIONS. (YES/NO)	BOOLEAN
67.0	IMPORT / EXPORT OF DATA THROUGH BCS CAN BE THROUGH ANY USB PORT OF PC / LAPTOP. (YES/NO)	BOOLEAN
68.0	BCS SOFTWARE HAS CAPABILITY TO CONVERT ALL THE DATA INTO ASCII FORMAT AS PER MSEDCL REQUIREMENT. (YES/NO)	BOOLEAN
69.0	BCS MAINTAINS AUDIT LOG FOR CONNECTION AND DISCONNECTION OF HHT TO BCS. (YES/NO)	BOOLEAN
70.0	BCS HAS OPTION OF DOWNLOADING AUDIT LOG. (YES/NO)	BOOLEAN
71.0	BCS MAINTAINS DOWNLOADED BILLING HISTORY. (YES/NO)	BOOLEAN
72.0	BCS STORES DATA TO DATABASE IN ENCRYPTED FORMAT. (YES/NO)	BOOLEAN
73.0	BCS GENERATES EXCEPTIONAL REPORT OF NEW METERS (METERS NOT AVAILABLE IN HHT INITIALLY) READING. (YES/NO)	BOOLEAN
74.0	API / EXE FILE WITH DOCUMENTATION FOR DOWNLOADING DATA FROM METER ALONG WITH SAMPLE METER IS SUBMITTED. (YES/NO)	BOOLEAN
75.0	API RESIDING ON HHT IS GIVEN FREE OF COST WITH ALL ITS DOCUMENTATION AND TRAINING. (YES/NO)	BOOLEAN

76.0	TOTAL TIME TAKEN FOR DOWNLOADING ALL DATA FOR 60 DAYS IS UP TO 26 MINUTES (YES/NO)	BOOLEAN
77.0	DOWNLOADING TIME OF ONLY BILLING DATA IS LESS THAN 25 SECS AFTER JOINING THE NETWORK (YES/NO)	BOOLEAN
78.0	COMMISSIONING AND DEPLOYMENT DOCUMENT OF HHT IS AS PER ANNEXURE VI. (YES/NO)	BOOLEAN
79.0	RF MODULE IS INBUILT IN HHT. (YES/NO)	BOOLEAN
80.0	BY DEFAULT, AFTER STARTING HHT IS METER READING MODE. (YES/NO)	BOOLEAN
81.0	MEMORY OF HHT IS 256 MB MIN. (YES/NO)	BOOLEAN
82.0	HHT POSSESSES SPECIFIC SERIAL NO. (YES/NO)	BOOLEAN
83.0	HHT IS PROPERLY LABELED WITH SERIAL NUMBER / TENDER NUMBER / PROGRAM NAME / PROGRAM VERSION. (YES/NO)	BOOLEAN
84.0	TEST OPTION FOR CHECKING CONNECTIVITY BETWEEN HHT & METER PROVIDED. (YES/NO)	BOOLEAN
85.0	HHT IS BASED ON OPEN ZIGBEE – 2007 PRO WITH SMART ENERGY PROFILE PROTOCOL AND 6LOWPAN PROTOCOL FOR INTEROPERABILITY AS PER SETTINGS GIVEN IN CLAUSE 5.28 AND ANNEXURE V & VI OF THE SPECIFICATIONS. (YES/NO)	BOOLEAN
86.0	PROVISION FOR AUTO POWER SAVE ON HHT. (YES/NO)	BOOLEAN
87.0	BIDDER AGREES TO SUPPLY HHT IN THE RATIO OF 1:250 INCLUDING USER MANUAL, AA SIZE BATTERIES & A SET OF DIRECT COMMUNICATION CORDS (YES/NO)	BOOLEAN
88.0	HHT CAPABLE FOR DOWNLOADING DATA OF MULTIPLE DESIGNS & MAKE OF METERS AS WELL AS FOR METERS ADDED IN NEXT 5 YEARS FOR THE COMMON COMMUNICATION PROTOCOL ATTACHED WITH THIS SPECIFICATION. (YES/NO)	BOOLEAN

89.0	METER SPECIFIC MRI PROGRAMS HAVE ABILITY TO USE HHT REAL TIME CLOCK TO TAG ALL TIME RELATED EVENTS. (YES/NO)	BOOLEAN
90.0	A REAL TIME CLOCK WITH A MINIMUM OF 15 DAYS BATTERY BACKUP WITH 30 YEAR CALENDAR IS PROVIDED IN HHT. (YES/NO)	BOOLEAN
91.0	TIME DRIFT OF THE RTC IN HHT DOES NOT EXCEED + / - 300 SECONDS PER YEAR. (YES/NO)	BOOLEAN
92.0	INDICATION FOR CONFIRMATION OF SUCCESSFUL DATA TRANSFER IS PROVIDED ON METER & HHT (YES/NO)	BOOLEAN
93.0	HHT DOES NOT ACCEPT ANY EXTERNAL FILE OTHER THAN BCS. (YES/NO)	BOOLEAN
94.0	HHT HAS AUDIT TRAIL LOG OF CONNECTION & DISCONNECTION OF HHT WITH BCS. (YES/NO)	BOOLEAN
95.0	USB PORT ARE PROVIDED ON HHT (YES/NO)	BOOLEAN
96.0	ONE CHORD OF MIN. 1 MTR LENGTH ARE PROVIDED WITH EACH HHT (YES/NO)	BOOLEAN
97.0	NECESSARY SOFTWARE CONFORMING TO THE ENCLOSED COMMUNICATION PROTOCOL, REQUIRED FOR HHT & BASE COMPUTER SYSTEM WITH NECESSARY SECURITY PROVISIONS IS SUPPLIED. (YES/NO)	BOOLEAN
98.0	HHT HAS OPTION TO CHECK READING STATUS (DOWNLOADED OR NOT DOWNLOADED) FOR ANY PARTICULAR METER. (YES/NO)	BOOLEAN
99.0	HHT INDICATES STATUS OF TOTAL CONSUMERS / METERS, NUMBER OF CONSUMERS / METERS READ AND BALANCE CONSUMERS / METERS. (YES/NO)	BOOLEAN
100.0	SEARCH FACILITY FOR THE BALANCE METERS PROVIDED ON HHT. (YES/NO)	BOOLEAN

101.0	HHT CAPABLE OF DOWNLOADING BILLING DATA OF AT LEAST 2,000 (TWO THOUSAND) METERS AT A TIME (YES/NO)	BOOLEAN
102.0	HHT SUPPLIED IS CAPABLE FOR DOWNLOADING DATA OF MULTIPLE DESIGNS & MAKE OF METERS (YES/NO)	BOOLEAN
103.0	HHT HAS FACILITY FOR RE-ENTERING METER SERIAL NUMBERS DIRECTLY FROM BASE COMPUTER SYSTEM (YES/NO)	BOOLEAN
104.0	HHT IS TYPE TESTED AS PER TECHNICAL SPECIFICATION (YES/NO)	BOOLEAN
105.0	TYPE TEST REPORT NO & DATE OF HHT	TEXT
106.0	METER IS TYPE TESTED (YES/NO)	
107.0	TYPE TEST REPORT NUMBER & DATE OF METER	
108.0	GUARANTEE 5 YEARS FROM INSTALLATION OR FIVE & HALF YEARS FROM DATE OF DESPATCH (YES/NO)	
109.0	IN HOUSE TESTING FACILITIES ARE AVAILABLE FOR (a) INSULATION RESISTANCE MEASUREMENT (YES/NO)	
110.0	(b) NO LOAD CONDITION (YES/NO)	
111.0	(c) STARTING CURRENT TEST (YES/NO)	
112.0	(d) ACCURACY TEST REQUIREMENT (YES/NO)	
113.0	(e) POWER CONSUMPTION (YES/NO)	
114.0	(f) TRANSPORTATION TEST (YES/NO)	
115.0	(g) FULLY COMPUTERISED METER TEST BENCH SYSTEM FOR CARRYING OUT ROUTINE AND ACCEPTANCE TEST IS AVAILABLE (YES/NO)	
116.0	(h) MANUFACTURER HAS CALIBRATED STANDARD METER OF 0.1 CLASS ACCURACY (YES/NO)	

117.0	(i) VERIFIACTION OF DATA DOWNLOADING AS PER RF PORT (YES/NO)	
118.0	(j) GLOW WIRE TESTING (YES/NO)	
119.0	FURNISH PRINCIPLE OF OPERATION OF METER OUTLINING METHODS AND STAGES OF COMPUTATIONS OF VARIOUS PARAMETERS STARTING FROM INPUT VOLTAGE AND CURRENT SIGNALS INCLUDING SAMPLING RATE IF APPLICABLE	
120.0	MANUFACTURING ACTIVITIES ARE AS PER CLAUSE 28.00 (YES/NO)	
121.0	QAP SUBMITTED AS PER ANNEXURE-I (YES/NO)	
122.0	METER & HHT COMPLIES WITH ANNEXURE IV, V & VI OF TECHNICAL SPECIFICATION (YES/NO).	
123.0	PERMANENT NATURE CONNECTION DIAGRAM OF METER IS SHOWN ON INSIDE PORTION OF THE TERMINAL COVER. (YES/NO)	
124.0	METER TERMINALS ARE MARKED AND THIS MARKING APPEARS IN THE ABOVE PERMANENT NATURE CONNECTION DIAGRAM. (YES/NO)	
125.0	NAME PLATE & MARKING AS PER CLAUSE NO. 18.00	
126.0	(a) THE BIDDER/MANUFACTURER SHALL HAVE SUPPLIED 12.5 LAKHS STATIC METER DURING THE LAST THREE FINANCIAL YEARS.	BOOLEAN
127.0	(b) THE BIDDER / MANUFACTURER SHALL HAVE MINIMUM EXPERIENCE OF THREE YEARS OF SUPPLY OR MANUFACTURING FOR STATIC METER UPTO THE END OF THE LAST FINANCIAL YEAR.	BOOLEAN
128.0	SPARK DISCHARGE TEST AT 35 KV IS CARRIED OUT AS PER CLAUSE 6.26 OF TECHNICAL SPECIFICATION (YES/NO)	BOOLEAN
129.0	FURNISH PHYSICAL WATER ABSORPTION VALUE	TEXT
130.0	FURNISH THERMAL HDDT VALUE	TEXT

131.0	FURNISH FLAMMABILITY VALUE	TEXT
132.0	FLAMMABILITY V2 (YES/NO)	TEXT
133.0	GLOW WIRE TEST AT 650° C (YES/NO)	BOOLEAN
134.0	TENSILE STRENGTH	BOOLEAN
135.0	FLEXURE STRENGTH	TEXT
136.0	MODULUS OF ELASTICITY	TEXT
137.0	IZOD IMPACT STRENGTH NOTCHED 23° C	TEXT
138.0	WHETHER 10 NOS. OF TENDER SAMPLE METERS ARE SUBMITTED ALONGWITH API SOFTWARE & DOCUMENTATION. (YES/NO)	BOOLEAN
139.0	AGEING TEST IS CARRIED OUT AS PER CLAUSE 29.04.04 OF TECHNICAL SPECIFICATION (YES/NO)	BOOLEAN
140.0	WHETHER THE FIRM IS SUBSIDIARY IF YES, WHETHER UNDERTAKING I.E. ANNEXURE-UI IS ENCLOSED (YES/NO)	BOOLEAN
141.0	ADDITIONAL INFORMATION REQUIRED IN CASE OF FOREIGN BIDDER / MANUFACTURER. 2. RATE OF CUSTOM DUTY	BOOLEAN
142.0	3. OFFER SUBMITTED BY FOREIGN BIDDER / MANUFACTURER.	TEXT
143.0	4. WHETHER OFFER SUBMITTED THROUGH AUTHORIZED ASSIGNEE / NOMINEE.	TEXT
144.0	5. IN CASE OFFER SUBMITTED THROUGH AUTHORIZED ASSIGNEE/ NOMINEE, WHETHER ANNEXURE UII SUBMITTED (YES/NO)	TEXT
145.0	6. ANNEXURE B-1 I.E. PRICE SCHEDULE SUBMITTED GIVING SPLIT UP IN US $ & INR AS PER ANNEXURE B-1. (YES/NO)	BOOLEAN