

**ELECTRICITY OF VIETNAM
HO CHI MINH CITY POWER CORPORATION**



EVN*HC***MC**

PROCUREMENT DOCUMENTS

**Bidding Document for
Procurement of Goods**

**Procurement of:
Meters and Head-End System
(HES) and Installation Service**

ICB No: DEP-AMR-G2

VOLUME 2

TECHNICAL DOCUMENT

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ABBREVIATIONS

AMI	Advanced Metering Infrastructure
AMR	Automated Meter Reading
CMIS	Customer Management Information System
CRM	Customer Relationship Management
EVN	Electricity of Vietnam
EVNHCMC	Ho Chi Minh City Power Corporation
HES	Head End System
IEC	International Electro-technical Commission
IP	Internet Protocol
ISO	International Organization for Standardization
MDMS	Metering Data Management System.
SIR	System Improvement Request
TOU	Time of Use

1. INTRODUCTION

This document describes the requirements to be met of the meters and Head-End System (HES) including communication network equipment for Ho Chi Minh City Power Corporation (EVNHCMC) of Electricity of Vietnam (EVN).

The purpose of the document is to familiarize the supplier with meet the requirements for all system components, as well as to provide additional clarifications that shall assist in the defining of wholesome functional requirements of applied systems.

1.1. AMR System Architecture of EVNHCMC

The components of the AMR system includes two main components as the following:

- Metering Data Management System (MDMS) comprises metering data and applications. Data transfer request should be executed consistently to and from MDM system. Data exchange between the MDM system and other systems include:
 - Meter Data from Head End System (HES)
 - Data (customer information, billing,...) from Customer Management Information System (CMIS)
 - Data exchange with other utility applications such as GIS, OMS, CRM, SCADA/DMS
 - Information related to tariffs and price structures
- Electronic meters and Head End System (HES). It shall comprise the component as show below:
 - Data Concentrator Unit (DCU) for collect metering data;
 - Communication facilities. Communication technologies based on one of the following technologies: RF mesh; Power Line Communication (PLC); cellular network (GPRS/3G); or equivalent which will be used to communicate with HES;

AMR system architecture of EVNHCMC as shown below:

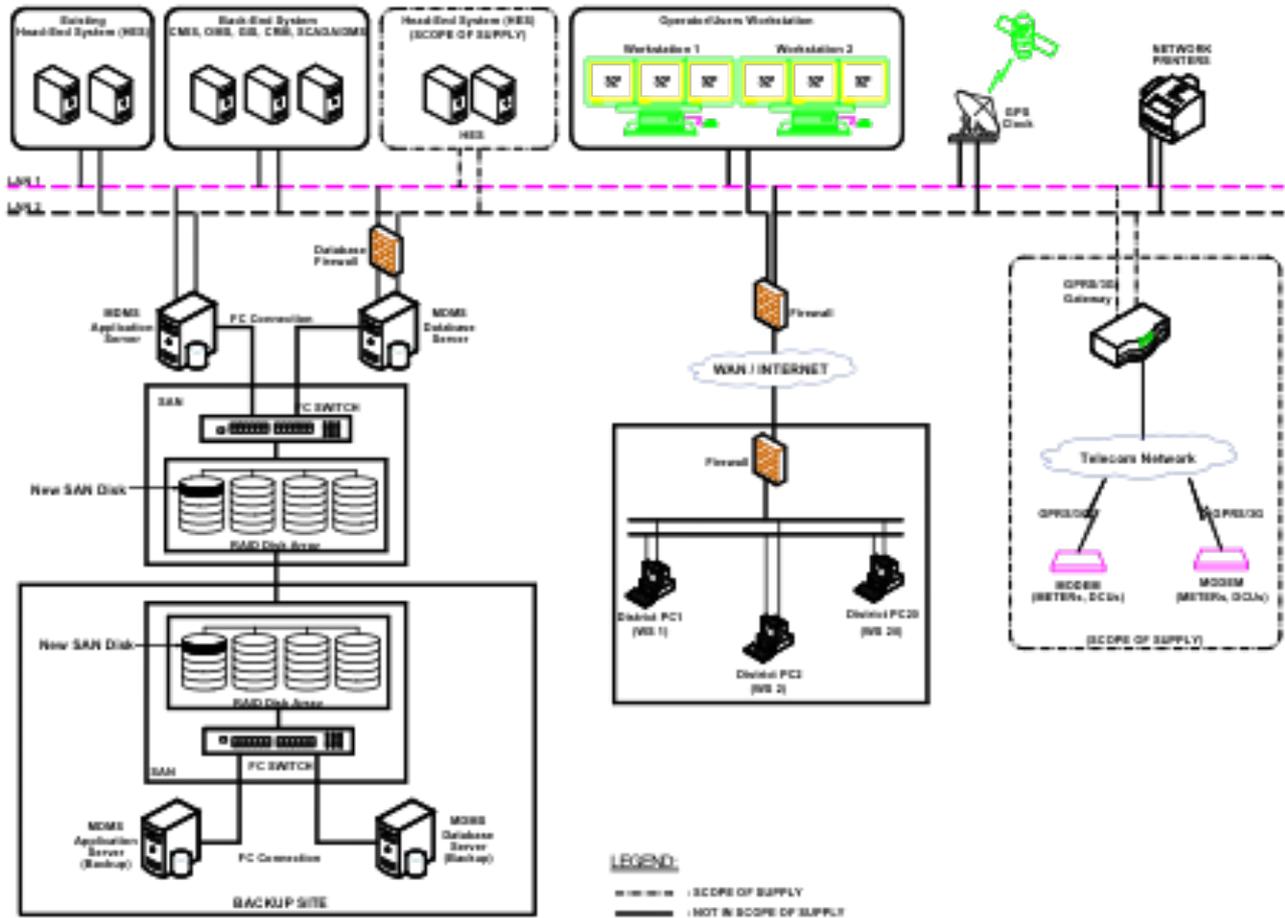


Exhibit 1 – EVNHCMC’s AMR System Architecture - Main Site

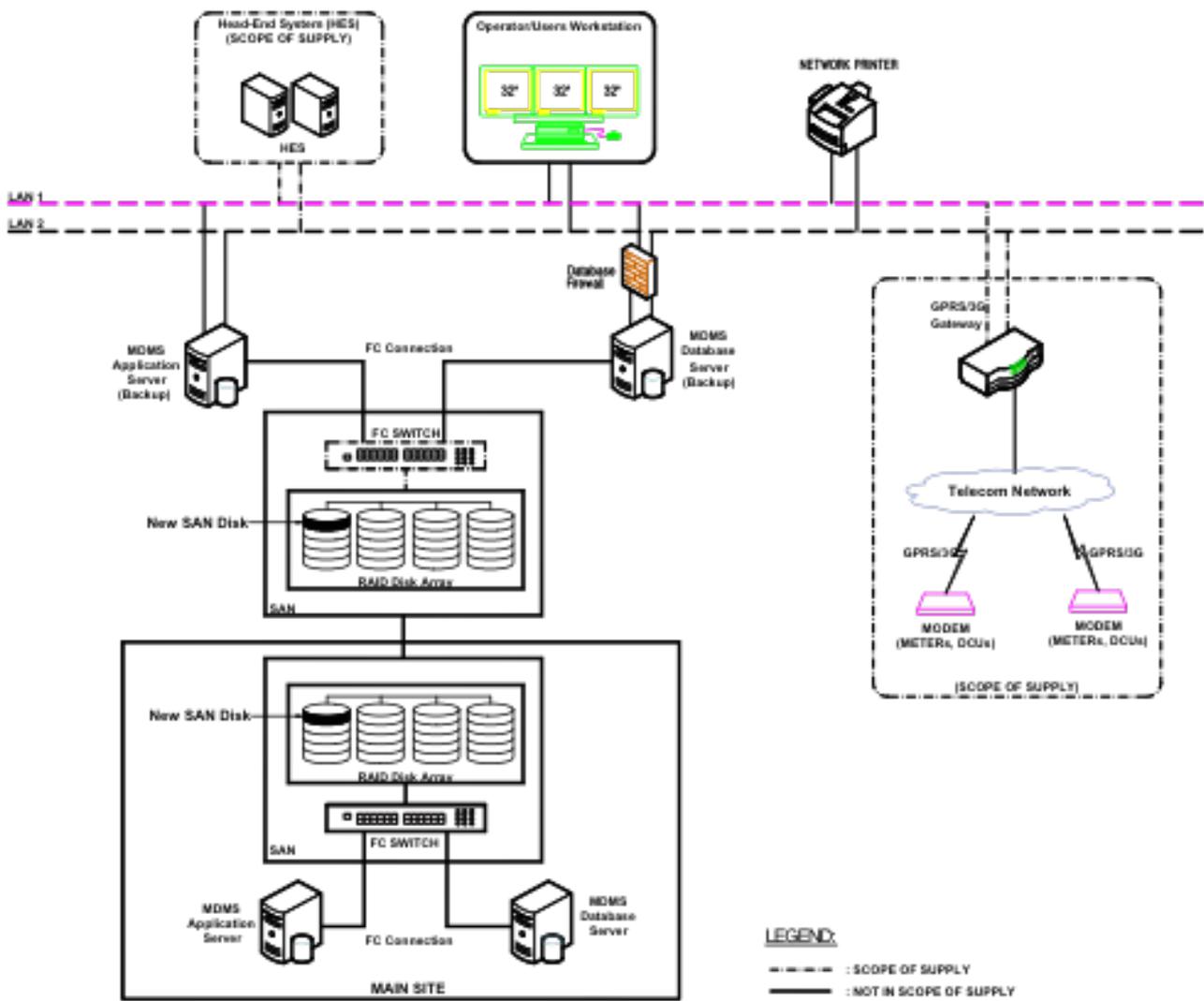


Exhibit 2 – EVNHCMC’s AMR System Architecture - Backup Site

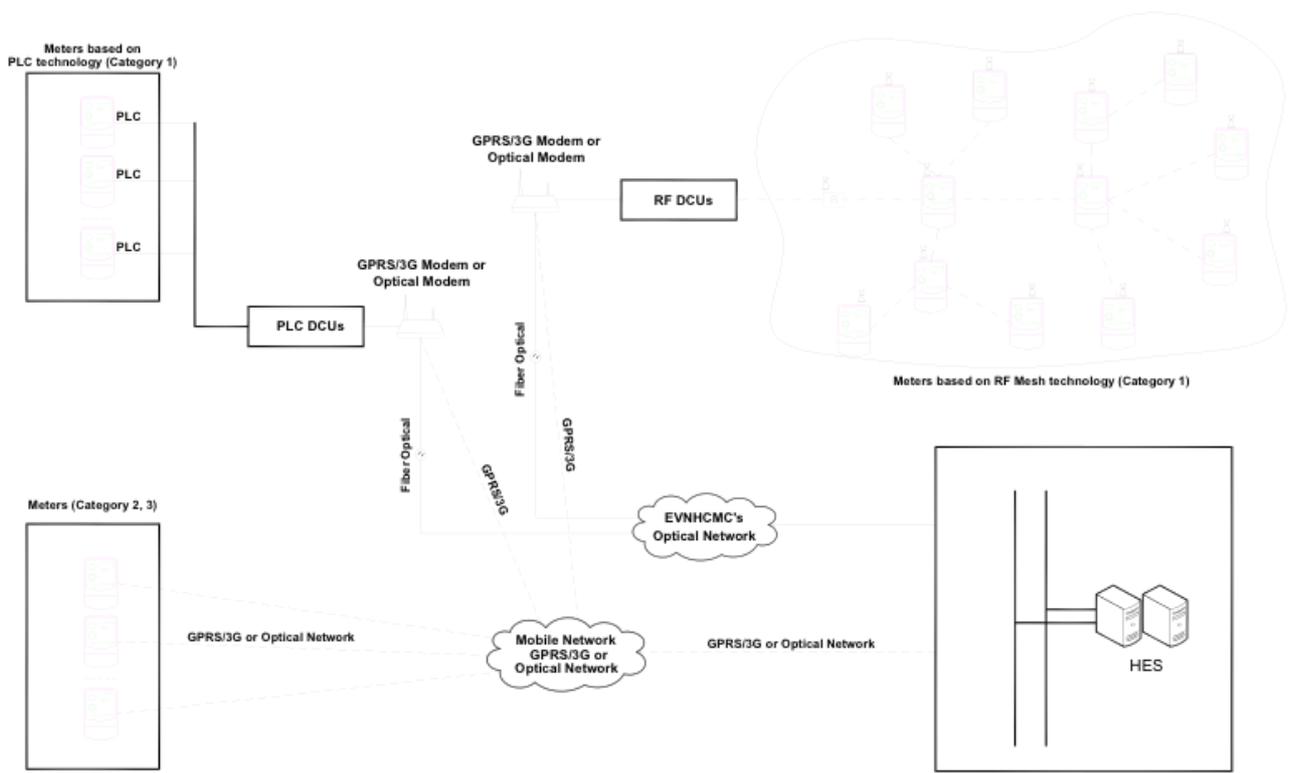


Exhibit 3 – Communication network for meters

1.2. Scope of Project

The project involves the meters, HES, and communication network for Ho Chi Minh City Power Corporations (EVNHCMC) of EVN.

The scope of project of the Supplier will include but not limited to the following:

- Designing and supplying the electronic meters, the hardware and software of the Head-end System (HES) and all of communication network equipment;
- Regional survey to propose the communication solutions for the meters. Models of network based on PLC technology and/or RF mesh technology;
- Providing the communication network between the meter and the HES at 2 sites;
- The installation and configuration of the data concentrator or any other communication equipment;
- Installation, configuration and building of the database for the HES at 2 sites;
- Connecting and data exchange between HES and MDM System at 2 sites;
- Implementation of the testing and commissioning;
- Provide maintenance and training services to the Employer.

The Employer will be responsible for installation and configuration of the meters under the supervision and support from the Supplier.

The scope of supply is described in Price Schedule, Section IV – Bidding Forms.

1.3. The system sizing

The purpose of this section is to describe the technical architecture overview and configuration specifications for AMR system implementation for the following deployment number of end-points:

- **95,300 meter**

Number of Meter	Type	Meter Read Details
49,500	Direct meter (1 or 3 phase meter, single tariff, only import energy)	Daily register reads (daily consumption)
31,300	Direct meter (1 or 3 phase meter, multi-tariff, only import energy)	Daily register reads and hourly interval reads (diagnostic events, electricity parameters)
12,500	Low voltage Indirect meter (3-phase meter, import/export energy, one direction)	Daily register reads and 30-minute interval reads (diagnostic events, electricity parameters)
2,000	Medium voltage indirect meter (3-phase meter, import/export energy, bidirectional)	Daily register reads and 30-minute interval reads (diagnostic events, electricity parameters)

2. TECHNICAL SPECIFICATION FOR ELECTRONIC METER

2.1. Scope of the Supply

- The meters shall be supplied complete with all the required hardware, firmwares, and other items necessary for its perfect operation;
- The Supplier shall be responsible for the execution of regional survey to propose the communication solutions for the meters. Models of network is based on PLC technology and/or RF mesh technology. The Employer will coordinate with the Supplier during the survey implementation.
- The Employer will be solely responsible for providing power cables and other accessories such as screws and bolts for installation the meters in this project.
- The Employer will be solely responsible for the execution of all the meters installation and configuration services.
- The Supplier shall be solely responsible for the execution of the supervision and support the Employer during the meters installation implementation.
- The meter boxes are not in scope of this project. All the meters shall be installed inside of the existing meter box with specific dimensions as shown in **Appendix 2.1 – Existing meter box**. In the case of the meter sizes do not fit with the existing meter box, the Supplier shall be responsible for providing new meter box.
- The Supplier shall provide the external testing entity certificate (such as DNV KEMA, NEMA, EPRI, etc.) that proves that the data concentrator unit are interoperable to at least three different meter manufactures based on the required functionalities in the bidding document for PLC and/or RF Mesh technology. In case of same manufacture, the Supplier shall offer the meter samples of two different manufactures for purpose of interoperability testing.
- The Supplier shall offer 5 categories according to PLC and/or RF mesh technology, requires five sample for each categories. The Supplier shall be responsible for the cost of these sample meters.

2.2. Metering Points Categories

AMR system of EVNHCMC shall require that the metering points be grouped into different categories that share similar technical and regulatory conditions.

In that sense, the following categories breakdown for metering points:

Table 1. Metering Categories

Metering Category	Description
1	Direct meters, single phase or 3-phase, single tariff and multi-tariff. This Category will be apply for the meters as the following:
1.1	Single phase meter, single tariff, directly, 10(40)A, 230V, accuracy class 1.0 with detachable PLC and/or RF mesh communication module
1.2	Single phase meter, single tariff, directly, 20(80)A, 230V, accuracy class 1.0 with detachable PLC and/or RF mesh communication module
1.3	3-Phase meter, single tariff, directly, 3*50(100)A-3*230/400V, accuracy class: 1.0(P), 2.0(Q) with detachable PLC and/or RF mesh communication module
1.4	Single phase meter, multi-tariffs, directly, 20(80)A, 230V, accuracy class 1.0 with detachable PLC and/or RF mesh communication module
1.5	3-Phase meter, multi-tariffs, directly, 3*50(100)A-3*230/400V, accuracy class: 1.0(P), 2.0(Q) with detachable PLC and/or RF mesh communication module
2	Indirect meter, single phase or 3-phase, multi-tariff. This Category will be apply for the meters as the following: 3-Phase meter, multi-tariffs, LV indirectly, 3*5(6)A, 3*220/380V or 3*230/400V, accuracy class: 1.0(P), 2.0(Q) with detachable GPRS/3G communication module
3	Medium voltage indirect meter (CT, VT meter), 3-phases. This Category will be apply for the meter as the following: 3-Phase meter, 3 tariffs, MV indirectly, 3*5(6)A, 3*57.7-120V, accuracy class: 0.5S(P), 2.0(Q) with detachable GPRS/3G communication module

2.3. Applicable Standards

The technical standards for electronic meters are applied include:

- IEC 62052-11:2003: Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 11: Metering equipment.
- IEC 62052-21:2004: Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 21: Tariff and load control equipment.
- IEC 62053-21:2003: Electricity metering equipment (AC) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2).
- IEC 62053-22:2003: Electricity metering equipment (AC) – Particular requirements – Part 22: Static meters for active energy (classes 0,2S and 0,5S).
- IEC 62053-23:2003: Electricity metering equipment (AC) – Particular requirements – Part 23: Static meters for reactive energy (classes 2 and 3).

- IEC 62053-31:1998: Electricity metering equipment (AC) – Particular requirements – Part 31: Pulse output devices for electromechanical and electronic meters (two wires only).
- IEC 62056-21, 31, 41, 42, 46, 47, 51, 52, 53, 61, 62: Electricity metering – Data exchange for meter reading, tariff and load control.
- IEC 60529: Degrees of protection provided by enclosures (IP Code).
- IEC 61000-4-2, 3, 4, 5, 6, 12: Electromagnetic Compatibility (EMC).
- IEC 60695-2-11: Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods. Glow-wire flammability test method for end-products
- IEC 60068-2-1, 6, 27, 30, 75: Environment testing

The meters shall be in conformity with the above technical standards. In regard to the standards mentioned the year of publication, it is applied to the releases with the year mentioned only. With the other standards, just be applied the latest releases, including the modifications.

If the meter has many different functional components which placed inside the meter's cover, it will be applied the relevant standards for each component.

If the above standards refers to the other relating standards, it will be applied the referred standard also.

For the meters that are announced comply with the other standards but differ with IEC standards, the other standards must be fully comparable with the corresponding IEC standards or the technical characteristics of the meters according to the other standards must be meet equivalent or better than the technical requirements of the respective IEC standards.

2.4. General requirements for electronic meters

2.4.1. The legal

The meter must be certified by Directorate for Standards, Metrology and Quality in Vietnam for the its samples.

2.4.2. Voltage

- Nominal voltage (phase – to – neutral)
 - The direct meter: 230V (or 220V – similarity)
 - The meter connected through the voltage transformer: 57.7V or 63.5V (it's optional which be in accordance with nominal secondary voltage of the voltage transformer connected to the meter)
- Normal operating voltage range: from 80% to 115% nominal voltage

2.4.3. Current

- The direct meter (base current/maximum current, I_b/I_{max}):
 - Single-phase meter: 5/20A, 10/40A or 20/80A (options according to demand)

- Three-phase meter: 10/40A, 20/80A, 50/100A (options according to demand)
- The meter connected through current transformer (Nominal current (In) or maximum current (Imax)):
 - Single-phase meter: 5/6A (comply with the current transformer connected to the meter with nominal secondary current is 5A)
 - Three-phase meter: 1/1,2A or 5/6A (comply with the current transformer connected to the meter with nominal secondary current is 1A or 5A)

** Note: If the meters that the Bidder offer have the voltage range and current range wider and cover the current range and voltage range above, it is considered as meet the requirements.*

2.4.4. Frequency

- Nominal frequency: 50Hz
- Normal operating frequency band: 50Hz ± 0,5Hz.

2.4.5. Printed circuit board and electronic component

The printed circuit board and electronic component of the meter shall be made by surface-mount technology (SMT), except some components that through hole soldering technology is required.

2.4.6. Power supply and Wiring connection

- The meter's power supply must be powered by AC power of measurement circuit.
- Type of wiring for single phase meter: 1 phase 2 wires (1 phase + 1 neutral wire).
- Type of wiring for 3-phase meter: 3 phases 4 wires (3 phase + 1 neutral wire). The 3-phase meters shall be ensured to maintain operating full of functions in case of power failure on any one or two phases.

2.4.7. Meter cover

2.4.7.1. General requirements

- The meter cover must have positons to seal by leads in such a way that the internal parts of the meter are accessible only after breaking the meter cover seals. The cover shall be screw down and just only be removed by tools. The meter cover that comprised of dangerous polluting material components (mercury, cadmium, cobalt etc.) are not allowed.
- If the whole or part of the meter cover is made up of metal material, it must have the grounded terminal for grounding protective.

2.4.7.2. Withstand vibration and mechanical impacts ability

- Withstand vibration ability: according to IEC 60068-2-6
- Withstand mechanical impacts ability: according to IEC 60068-2-75

2.4.8. Display Window

If the meter cover don't made of transparent material, it must have the window to read the display content and observe the indicators of meter. This window must be made of transparent material, could not removable and withstand solar radiation.

2.4.9. Terminal – Terminal base

- The terminals are arranged adjacently, follow on queue on one block attached to the body of meter.
- Connecting cable to the terminals is performed by using screws with touch transmission force, make sure that the contacting between the terminals and the cables is firm and long-lasting so that no risk of loosening or overheating can appear. Make sure that the fixing screws is not rusty and firmly connected to the copper terminals. The current circuit terminals must have at least 2 fixed screws.
- Size of the hole in the voltage circuit terminals (through VT): diameter of 4mm minimum.
- Size of the hole in the current circuit terminals:
 - To the meter through CT: diameter of 4mm minimum.
 - To the direct meter with $I_{max} < 40A$: diameter of 5mm minimum.
 - To the direct meter with $40A < I_{max} \leq 80A$: diameter of 6mm minimum.
 - To the direct meter with $I_{max} > 80A$: diameter of 8mm minimum.
- The terminal cover must be separated from the meter cover and have positions of lead seals independently with meter cover. The terminal cover must cover all the cable terminal, fixing screw and part of wires to make sure that the terminals cannot be accessed without breaking the lead seals.
- The base and the terminal cover must ensure of withstand overheating, against fire spread, not be catching fire in case of exposed to overheated electrical parts.
- The base and the terminal cover that comprised of dangerous polluting material components (mercury, cadmium, cobalt, etc.) are not allowed.

2.4.10. Insulation protection

- Insulation protection class: 2
- Ensure AC voltage test, according to IEC 62053-21,22
- Ensure impulse voltage test, according to IEC 62052-11.

2.4.11. Air clearance and creepage distance

The air clearance and creepage distance shall be ensured comply with IEC 62052-11 in regard to insulation protection class 2.

2.4.12. Heat resistance and flame retardant ability

The base of terminal, terminal cover and meter cover must ensure to resist spread of fire and it may not catching fire when exposed to overheated electrical parts, according to IEC 60695-2-11, with temperatures:

- The base of terminal: $960 \pm 15^{\circ}\text{C}$
- Terminal cover and meter cover: $650 \pm 10^{\circ}\text{C}$
- Testing time: 30 ± 1 second

2.4.13. Water/dust protection

Protection class that against dust and water from entering in the meter cover must be at least IP-51, comply with IEC 60529.

2.4.14. The Display

- The meter must have the LCD screen to display the measuring parameters. The LCD screen must have capable of withstand to normal operating, storage and the transportation ranges of the meter.
- The measured values are displayed by digit characters with minimum sizes is 6mm x 4mm (height x wide). The digit characters can be displayed by numbers from “0” to “9”.
- For meter using LCD screen, it’s no required battery to supply power for screen when the meter de-energization.
- For meter using mechanic digit, the digits will be not blur. The decimal digit shall be painted color different from integral digit.
- Unit of measurement is (kWh), (kVArh) or (MWh), (MVArh).

2.4.15. The LED indicator for Meter constant

The meter must have LED indicator to generate the testing impulse that equivalent to the meter constant which located on the front of the meter and comply with IEC 62052-11 and IEC 62053-31.

2.4.16. Nameplate and markings

Meters shall be provided with a clearly visible nameplate. The nameplate must be secured against removal and must be printed at least the following information:

- The identification of the meter sample’s certificate (for domestic meters).
- The name of the manufacturer or trademark, country of manufacture, production year.
- Type of meter.
- Number of phases and number of measurement circuit’s wires or using the standard diagram for wiring.

- Meter's serial number and year of manufacturing: expressed as numbers and barcodes. The year of manufacturing may be combined to the serial number when printing. Each of meter have a unique serial number and barcode and it must be saved permanently in meter and it cannot be erased or modified.
- Nominal voltage (V)
- Nominal current and maximum current (A).
- Nominal frequency (Hz).
- Meter constant (pulse/kWh, pulse/kVARh or Wh/pulse, Varh/pulse).
- The meter's accuracy for measuring active and reactive energy comply with relative standard.
- Standard temperature (if differ from 23°C)
- Insulating protection class of meter cover.
- Number of phases and number of measurement circuit wires of the meter (can be replaced by the wiring diagram that comply with IEC60387). The wiring diagram and the wiring terminal symbols must be show on the meter cover or the terminal cover.

2.4.17. Environmental conditions

- Temperature:
 - Normal operating temperature ranges: from -5°C to 55°C
 - Limiting operating temperature ranges: from -10°C to 70°C
 - Transporting and storage temperature ranges: from -10°C to 70°C
- Relative humidity
 - Yearly average: 75%
 - 30 days spread over the year: 95%
 - Occasionally for another day: 85%
- Elevation above sea level: minimum of 1,000m

2.4.18. Starting

- Initial starting time: the meter shall start within 5s after the meter is powered up.
- Starting current:
 - Direct meter:
 - 0.4% Ib for meter with accuracy class 1.
 - The meter connected through Current Transformer (CT):
 - 0.2% In for meter with accuracy class 1.
 - 0.1% In for meter with accuracy class 0.5 and 0.2.

2.4.19. Power consumption

The power consumption of the voltage circuit and current circuit shall comply with the IEC 62053-21,22, specified as follow:

- Voltage circuit (for all meters): $\leq 2W/10VA$
- Current circuit:
 - For Class 1 meters: $\leq 4VA$
 - For Class 0.5 and 0.2 meters: $\leq 1VA$

2.4.20. Withstand to short time overcurrent ability

The ability of withstand to short time overcurrent shall comply with IEC 62053-21,22.

- For class 1 meters:
 - The direct meter: have capable of carrying 30 I_{max} with relative tolerance from 0% to -10% in the half of cycle at nominal frequency.
 - The indirect meter through CT: have capable of carrying 20 I_{max} with relative tolerance from 0% to -10% for 0.5s.
- For class 0.5 and 0.2 meters:
 - The meter is capable of carrying 20 I_{max} with relative tolerance from 0% to -10% for 0.5s.

2.4.21. Electromagnetic Compatibility (EMC)

The meter shall meet the EMC test according to IEC 61000-4-2, 3, 4, 5, 6, 12

2.4.22. Self-diagnosis

The meter shall have the capability to regularly perform a complete self-check of its circuits, initial memory locations, integrity of data and parity. If an error appears in internal components (such as print circuit board, memory, etc.), the meter shall alert error by symbols on the display screen or other indicator on the meter.

2.4.23. Testing certificate

The meter must be achieved all the testing certificates as follow:

- Electrical insulation test
 - AC voltage test
 - Impulse voltage test
- Measurement test
 - Fundamental error test
 - Threshold of sensitivity test
 - Starting current and no load test

- Meter constant test
- Impact of changes in environment temperature test.
- Impact of changes in voltage test.
- Impact of changes in frequency test.
- Impact of reverse phase sequence test.
- Impact of unbalance voltage test.
- Impact of harmonic components test.
- Impact of external magnetic field test.
- Electromagnetic compatibility (EMC) test.
 - Immunity to impulse test
 - Immunity to damping oscillation test.
 - Immunity to electrostatic discharge test.
 - Immunity to HF electromagnetic field test.
 - Immunity to interference induced by HF electromagnetic field test.
 - Transient response test.
 - Radio frequency interference measurements.
- Test of electric requirements:
 - Consumption power test
 - Impact of spontaneous combustion test.
 - Impact of supply voltage test.
 - Impact of short time overcurrent test.
- Impact of environment test
 - Dry heat test
 - Cold test
 - Cycling hot and humid test
 - Accuracy test after Impact of climatic test
- Mechanical requirements testing:
 - Vibration test
 - Impact test
 - Ingress Protection (IP) test
 - Refractory, flameproof test
- Test for the multi-tariff meters
 - Accuracy of timer test
 - Switching time test

- Power register test
- Maximum power register test

2.4.24. Technical document

The technical documents of meters includes:

- Documents showing detailed about technical specifications, testing instructions, installation, operation and maintenance.
- Documents showing detailed about instruction of communication protocols of the meters for local and remote reading meter data.

2.4.25. Additional requirements for technical document

2.4.25.1. Technical documentation requirement for meters

The Supplier shall provide the technical documentation as the following:

- 1) The compliance of technical requirements in the form prescribed in Section VII – Schedule of requirements, Table of Compliance, Annex 1.1; Annex 1.2; Annex 1.3, Annex 1.4; Annex 1.5; Annex 2; Annex 3.
- 2) Catalogue of materials and equipment offered with description of technical specifications as described in Section 2.4 & 2.5.
- 3) A copy of the certificate of quality management system for major equipment manufacturers and manufacturer / assembler complete equipment offered. The above mentioned certificate shall be valid until the date of bid opening.
- 4) Certificate of successful operation from end users issued with complete the following information: name, code of manufacture and period of successful performance (at least 5 years) from the start of operation to date confirm successful operation.
- 5) The written warranty: minimum warranty period shall be three (3) years from the date of release of goods acceptance record of final delivery.
- 6) A copy of the Type Test report as specified in Section 2.4.23 – Testing certificate
- 7) The Type Test report shall meet the following requirements:
 - a) The Sample Test shall be received from the manufacturer.
 - b) Performing testing company
The Testing Company shall independent from the manufacturers and legitimate or The Testing Company is the manufacturer, the testing shall witnessed by organizations with independent testing functionality and legal.
 - c) Sample Test
Manufacturer, codes and technical specifications of the sample test shall conform to materials and equipment offered.
 - d) Categories and test results
Response the following conditions:

- Having full mandatory test items offered in bidding document and the results of compliance of requirement in the bidding document.
- Having full test items not mandatory provided in bidding document and the results of compliance of requirement in the bidding document.

or

- Having full mandatory test items offered in bidding document and the results of compliance of requirement in the bidding document.
- Having a written commitment to provide test items that are not mandatory to supply with tender document as specified in the bidding documents.

2.4.25.2. Technical documentation requirement during contract negotiation process

In case of necessity, the Employer may request the comparison of the original documents such as a type test report, certificate of quality management system, written confirmation of successful operation,... etc. in the process of Contract negotiation.

2.4.25.3. Technical documentation provision requirement prior to delivery

2.4.25.3.1.Documentation

The Supplier shall supply for the Employer a full original of the following documents:

- 1) Reports of the Routine test:
 - Reports of the regular testing by the manufacturer to perform on each product before delivery.
 - Having full mandatory test items offered in bidding document and the results of compliance of requirement in the bidding document. Section VII- Technical of requirements
- 2) Certificate of quality and quantity:
 - Certificate of quality and quantity shall be performed by the manufacturer.
 - Manufacturers shall certify all the equipment supplies provided in the contract which have not been used yet and the quality meets the technical requirements specified in the contract.
- 3) The warranty certificate.

2.4.25.3.2.Delivery schedule and document review

- The Supplier shall provide the Employer the documents which are specified in Section 2.4.25.3.1 prior to delivery for the Employer to review and comments.
- Progress providing documentation of the Supplier and the Employer's response:
 - The Supplier provides the Employer with technical documentation seven days before the first day of delivery.
 - The Employer shall respond in writing within 07 days since the day receiving documentation written by the Supplier.
- If any Routine Test report does not meet the requirements stipulated in the Contract, the Employer may refuse to accept the corresponding product with unsatisfactory

Routine Test reports. The Employer shall not grant upon any modification on the routine test report regular provided to the Employer and the Supplier is responsible for providing quality products to replace, any related costs by at the Supplier.

- The delivery is done only after the Employer has the acceptance certificate of the documents mentioned above.

2.4.25.4. Technical document requirements attached to each product when delivery

Attaching products to delivery, the Supplier shall provide the following documents:

- A copy of the Routine Test report.
- A copy of the certificate of quality.
- A copy of the warranty certificate.
- Documents showing detailed technical specifications, testing instructions, installation, operation and maintenance by Vietnamese language.

2.4.25.5. Acceptance

- Since the Supplier are selected, Ho Chi Minh City Power Corporation (the Employer) and the Supplier will negotiate to choose an independent testing company, legitimate to testing, test, evaluate and issue the quality certificate to the entire shipment. The certificates shall evaluate the quality of entire shipment that meets the technical requirements specified in the bidding document or not in order to use as a basic of acceptance the Contract between the Employer and the Supplier.
- Samples for testing will be conducted on randomly on the samples from shipments with the witness between the Employer, Suppliers and Testing Company. The number of samples test for each batch, testing methodology and quality evaluation will be decided by the Testing Company.
- The damaged or deformed samples are not taken into the numbers of delivery.
- The Employer will conduct acceptance the shipment after receiving the certificate recognized that the quality of goods as stipulated in the bidding document.
- All costs related to testing shall be responsible by the Supplier.

2.4.25.6. Registration sample approval

- The Supplier shall supply the Sample Approval Certificate for the meters offered under this Contract as base for selling energy to customers.
- The approval of samples shall conducted according to the Regulation on measurement for materials group 2 issued attachment to Circular No. 23/2013 / TT-BKHCN.
- All costs related to the sample approval shall be responsible by the Supplier including the costs, fees, schedule and contact with sample approval agency (the Employer have responsibility to fully provide documents related to the work of registration sample approval for the Supplier).
- The deadline for providing Sample Approval Certificate for the offering meters: 10 days prior to first batch of delivery.

2.4.25.7. Software updates for electronic meters

- For the electronic meters which are first sold to Ho Chi Minh City Power Corporation, the Supplier shall in advance to send to the Employer 03 sample meters which no later than 06 weeks before the first delivery so that the Employer to perform update software of testing desk.
- The Supplier shall responsible for coordinate with the Employer to ensure that the testing desk at the Testing Company of HCMC Power Corporation testing these meters. These amount of samples is not taken into the numbers of delivery under the Contract.

2.5. Specify technical requirements

2.5.1. Technical Characteristics and Functional Requirements For Meters Item 1.1, 1.2, and 1.3 in Table 1

- Type of meter: single or three phase, single tariff (no programmable).
- The meter shall measure and register active energy in one direction (the first quadrant) with accuracy class 1 according to IEC 62053-21.
- Information display
 - Single-phase meter
 - Cumulative power. Display format: minimum 5 integer digit and 1 decimal digit. Unit: kWh.
 - Phases Voltage and Current, total power factor
 - Warning of errors and events: reverse power, hardware failure.
 - In cases display many different information, the screen will display style automatic scrolling or manually with the button
 - Three-phase meter
 - Cumulative power. Display format: minimum 6 integer digit and 1 decimal digit. Unit: kWh.
 - Voltage and Current
 - Warning of errors and events: reverse power, error phase voltage, reverse phase current, hardware failure.
 - In cases display many different information, the screen will display style automatic scrolling or manually with the button
- Communication:
 - The meters have a detachable communication module to transmit data from meters to data concentrator unit (or vice versa) by using RF mesh or PLC technology.
 - Data transmission rates at minimum is: 1200 bps
 - The signal interface and data access protocol shall be provided and detail described by the manufacturer.

- Additional requirements of communication module
 - The transmission technology will change when changing the module.
 - The module must be powered by the meter power supply.
 - The module must operate stably and has compact size, small power consumption, and high anti-disturbance ability.
 - ~~If the RF module is selected for installation, it must include the easy removable antenna.~~
 - Communication module shall have a built-in protection against unwanted access. Access from which communication is allowed is entered as a parameter in the communication module.
 - ~~The communication module has to be equipped with a function to maintain the communication channel active even if the equipment has not been used for a longer time (this time represents a parameter).~~
 - The communication module must be installed inside the meter at a place so that when need to inspect or replace it, operator don't remove the testing sealed leads of the meter. The connectors and cables of communication module are under the responsibility of the supplier.

2.5.2. Technical Characteristics and Functional Requirements for Meters Item 1.4, 1.5, and 2 in Table 1

- Single and three-phase meters, multi-tariff, programmable. The configuration of meter can be saved to file format to reuse when necessities.
- The meter shall measure active and reactive energy in one direction (the first quadrant) with accuracy class as follow: Active power with accuracy class 1 according to IEC 62053-21 and reactive power with accuracy class 2 according to IEC 62053-23.
- Power quality monitoring:
 - Meter shall record events of under voltage and overvoltage as well as power loss.
 - Events related to under voltage and overvoltage shall be recorded in the meter. Threshold of under voltage and overvoltage can be programmed.
 - These events won't be recorded in the meter unless they continue for equal or much more time than the time set up for under voltage and overvoltage threshold. This time may be adjusted between 1 to 60 seconds (by 1 sec. steps).
 - For each time the under voltage or overvoltage appear, the voltage value during one period shall be detected and recorded.
 - Parameters related to voltage threshold and occurring duration of under voltage and overvoltage shall be adjusted locally.
 - Events related to power loss shall be recorded in the meter as follows: Record at least 5 latest events of power loss along with the time of power loss, the time that the power is powered up again for each event.
- Internal memory:

- The meter shall have non-volatile memory to store the metering data and events, meter's information.
- In case of power loss, basic data such as consumed energy for billing, cumulative energy, energy under tariffs, load profile; meter serial number, calendar, tariff switchover time; events, fault alarms shall be saved in non-volatile memory.
- Time of Use (TOU):
 - At least 3 tariff and 8 programmable tariff switchover time in a day. Each tariff can be programmed the activation time independently. The starting and finishing time of each tariff are fixed in any hours and minutes within a day.
 - Enable programming the tariff for working day and weekend.
 - The activated tariff shall be market on the display screen.
- Energy register and the maximum power by time of use:
 - At least 3 active energy registers by tariff
 - At least 3 maximum active energy registers by tariff
- Security: The meter shall have security facility to protect the local and remote access to the meter by using different password according to the following three levels:
 - Level 1: Meter reading
 - Level 2: Meter time synchronization
 - Level 3: Meter configuration and set up the password of level 1 and level 2. In case of the level 3 password is used with a hard key on the meter, this key shall be arranged conveniently when operating without removing the meter cover and it shall be protected by sealed cover plate and cannot access to the hard key without breaking the seal.
- The timer and schedule in meter:
 - Schedule in the meters in calendar, with leap year.
 - The meter shall have internal integrated timer with accuracy comply with IEC 62054-21.
 - The timer shall be synchronized by timestamp signals received through the local or remote communication interface. The meter will record at least 5 latest events which synchronous in non volatile memory of meter
- Battery power supply for real-times clock in meter:
 - The battery that supply power for the real time clock inside the meter must be the DC type without reload, at least 10 years of life expectancy.
 - The meter must generate a warning signals when the battery nearly empty.
- Billing data:
 - The meter must have capable of automatically latching billing data cyclical or manually by pressing the reset button of the meter. The reset button shall be

protected and have a place to seal, the button must not be accessible without breaking the seal.

- The automatic cycle to latch the billing data can be programmable at least once for a month at 0h00 of any day of the month.
- The meter must store at least the data of 12 most recent billing
- Each billing shall be recorded the following data into memory
 - Cumulative active energy
 - Active energy under tariff
 - Maximum active energy under tariff and time.
 - Cumulative reactive energy
 - The start and end time of billing cycle
- Load Profile:
 - The meter shall record active energy and reactive energy profile for each interval cycle, along with the events of the meter that relate to data of the profile (if available) into non-volatile memory.
 - Interval: can be programmable in the frame time: 1, 15, 30, or 60 minutes in each hour.
 - Be capable of storage at least 60 days of active and reactive power profile with interval of 30 minutes.
- Display information:
 - The data display on meter can be chosen randomly by user. The meter must have at least 2 display mode:
 - Auto scroll display mode: the parameters that was programmed to display in this mode in sequence.
 - Manual display mode: this is the display mode that replace for the auto scroll display mode. The parameters that was programmed to display in this mode will display sequentially after pressing a button.
 - Accumulating active energy, tariff active energy, accumulating reactive energy (current values and billing values). Display format: at least 8 digits (for three phase meter) and 7 digits (for single phase meter), can be programmed up to 2 digit after decimal. Unit: kWh, kVArh or MWh, MVAh.
 - Maximum active power in each tariff and time of occur. Values of the register will be saved to internal memory of meter and automatically return to “0” at the data latching time.
 - Voltage, current of each phase and average power coefficient of three phase.
 - Instantaneous active and reactive power.
 - The present activated tariff.
 - Date, month, year and current time. Format of date and time: dd-mm-yy and hh:mm:ss.

- Multiplier factor (with indirect measurement meter)
- Phase sequence (with three phase meter)
- Recording and warning of error and events:
 - Single phase meter: reverse power, overcurrent, overvoltage, voltage drop, low battery, and hardware failure of meter. The events are recorded in meter along with the time occur.
 - Three phase meter: reverse power, phase voltage error, phase current reversed, overcurrent, over voltage, voltage drop, low battery, incorrect phase sequence, and hardware failure of meter. The events are recorded in meter along with the time occur.
- Communication:
 - The meter can be programmed through optical bidirectional port complied with the IEC 62056-21 and minimum data transmission speed is 2400bps. The optical port shall be on the surface of meter, using infrared signals, can be connected to external optical devices into meter safely.
 - The meters have a detachable communication module to transmit data from meters to Head End System and data concentrator unit (or vice versa) by using RF mesh or PLC or GPRS or 3G or RS485 technology.
 - Data transmission rates at minimum is: 1200 bps
 - The signal interface and data access protocol shall be provided and detail described by the manufacturer.
- Additional requirements of communication module
 - The transmission technology will change when changing the module.
 - The module must be powered by the meter power supply.
 - The module must operate stably and has compact size, small power consumption, and high anti-disturbance ability.
 - ~~If the RF or GPRS/3G module is selected for installation, it must include the easy removable antenna.~~
 - ~~Communication module shall have a built-in protection against unwanted access. Access from which communication is allowed is entered as a parameter in the communication module.~~
 - ~~The communication module has to be equipped with a function to maintain the communication channel active even if the equipment has not been used for a longer time (this time represents a parameter).~~
 - The communication module must be installed inside the meter at a place so that when need to inspect or replace it, operator don't remove the testing sealed leads of the meter. The connectors and cables of communication module are under the responsibility of the supplier.
- Meter programming software:
 - The meter shall allow local and remote setting.

- The software must enable full programming, backup and retrieve the measuring data of the meter and events from the meter.
- The any new release of the software can be used to program for the meters that previously purchased.
- Configuration files from older software version shall be operable in any newer versions
- The software must enable to export the metering data, events and configurations from the meters to text files (.TXT, .CSV, .XML) with a database structure
- Allow resetting value of the cumulative energy registers and energy under tariff register return “0” value by using level 3 password combined with impacting on the hardware component located inside the meter.
- When configuring parameters of the meter, the meter do not stopping and affect to meter's metrology.
- Operating in Windows 7 or later versions.

2.5.3. Technical Characteristics and Functional Requirements For Meters Item 3 in Table 1

- Three-phase meters, multi-tariff, programmable. The configuration of meter can be saved to file format to reuse when necessities.
- The meter shall measure active and reactive energy in bidirectional (quarter quadrant) with accuracy class as follow: Active power with accuracy class 0,5 (or class 0,2 in some specific cases) according to IEC 62053-22 and reactive power with accuracy class 2 according to IEC 62053-23.
- Power quality monitoring
 - Meter shall record events of under voltage and overvoltage as well as power loss.
 - Events related to under voltage and overvoltage shall be recorded in the meter. Threshold of under voltage and overvoltage can be programmed.
 - These events won't be recorded in the meter unless they continue for equal or much more time than the time set up for under voltage and overvoltage threshold. This time may be adjusted between 1 to 60 seconds (by 1 sec. steps).
 - For each time the under voltage or overvoltage appear, the voltage value during one period shall be detected and recorded.
 - Parameters related to voltage threshold and occurring duration of under voltage and overvoltage shall be adjusted locally.
 - Events related to power loss shall be recorded in the meter as follows: Record at least 5 latest events of power loss along with the time of power loss, the time that the power is powered up again for each event.
- Internal memory:

- The meter shall have non-volatile memory to store the metering data and events, meter's information.
- In case of power loss, basic data such as consumed energy for billing, cumulative energy, energy under tariffs, load profile; meter serial number, calendar, tariff switchover time; events, fault alarms shall be saved in non-volatile memory.
- Time of Use (TOU):
 - At least 3 tariff and 8 programmable tariff switchover time in a day. Each tariff can be programmed the activation time independently. The starting and finishing time of each tariff are fixed in any hours and minutes within a day.
 - Enable programming the tariff for working day and weekend.
 - The activated tariff shall be market on the display screen.
- Energy register and the maximum power by time of use:
 - At least 6 active energy register by tariff (3 for the export direction and 3 for import direction)
 - At least 6 maximum active energy register by tariff (3 for the export direction and 3 for import direction). The values of registers will be saved to internal memory of the meter and automatically return to "0" at time of latching billing data.
- Security: The meter shall have security facility to protect the local and remote access to the meter by using different password according to the following three levels:
 - Level 1: Meter reading
 - Level 2: Meter time synchronization
 - Level 3: Meter configuration and set up the password of level 1 and level 2. In case of the level 3 password is used with a hard key on the meter, this key shall be arranged conveniently when operating without removing the meter cover and it shall be protected by sealed cover plate and cannot access to the hard key without breaking the seal.
- The timer and schedule in meter:
 - Schedule in the meters in calendar, with leap year.
 - The meter shall have internal integrated timer with accuracy comply with IEC 62054-21.
 - The timer shall be synchronized by timestamp signals received through the local or remote communication interface. The meter will record at least 5 latest events which synchronous in non-volatile memory of meter
- Battery power supply for real-times clock in meter:
 - The battery that supply power for the real time clock inside the meter must be the DC type without reload, at least 10 years of life expectancy.
 - The meter must generate a warning signals when the battery nearly empty.
- Billing data:

- The automatic cycle to latch the billing data can be programmable at least once for a month at 0h00 of any day of the month.
- The meter must store at least the data of 12 most recent billing
- Each billing shall be recorded the following data into memory:
 - Import and export cumulative active energy
 - Import and export active energy under tariff
 - Maximum import and export active energy under tariff and time.
 - Cumulative import and export reactive energy
 - The start and end time of billing cycle
- Load Profile:
 - The meter shall record active energy (export and import) and reactive energy (export and import) profile for each integral cycle, along with the events of the meter that relate to data of the profile (if available) into non-volatile memory.
 - Integral cycle: can be programmable in the frame time: 1, 15, 30, or 60 minutes in each hour.
 - Be capable of storage at least 30 days of active power profile (import and export) and reactive power profile (import and export) with integral cycle is 30 minutes.
- Display information:
 - The data display on meter can be chosen randomly by user. The meter must have at least 2 display mode:
 - Auto scroll display mode: the parameters that was programmed to display in this mode in sequence. Also, it possible via keypad to display each parameter at discretion.
 - Manual display mode: this is the display mode that replace for the auto scroll display mode. The parameters that was programmed to display in this mode will display sequentially after pressing a button.
 - Import and export accumulating active energy, tariff active energy, accumulating reactive energy (current values and billing values). Display format: at least 8 digits, can be programmed up to 2 digit after decimal. Unit: kWh, kVArh or MWh, MVARh.
 - Maximum import and export active energy in each tariff and time of occur. Maximum power values of billing cycle will be saved to internal memory of meter and register of maximum power will be set to “0” when the meter automatically or manually performs latching billing data.
 - Voltage, current of each phase and average power coefficient of three phase.
 - Instantaneous active and reactive power.
 - Recording and warning of errors and events on display screen: reverse power, phase voltage error, phase current reversed, overcurrent, over voltage, voltage

drop, low battery, and hardware failure of meter. The events are recorded in meter along with the time occur.

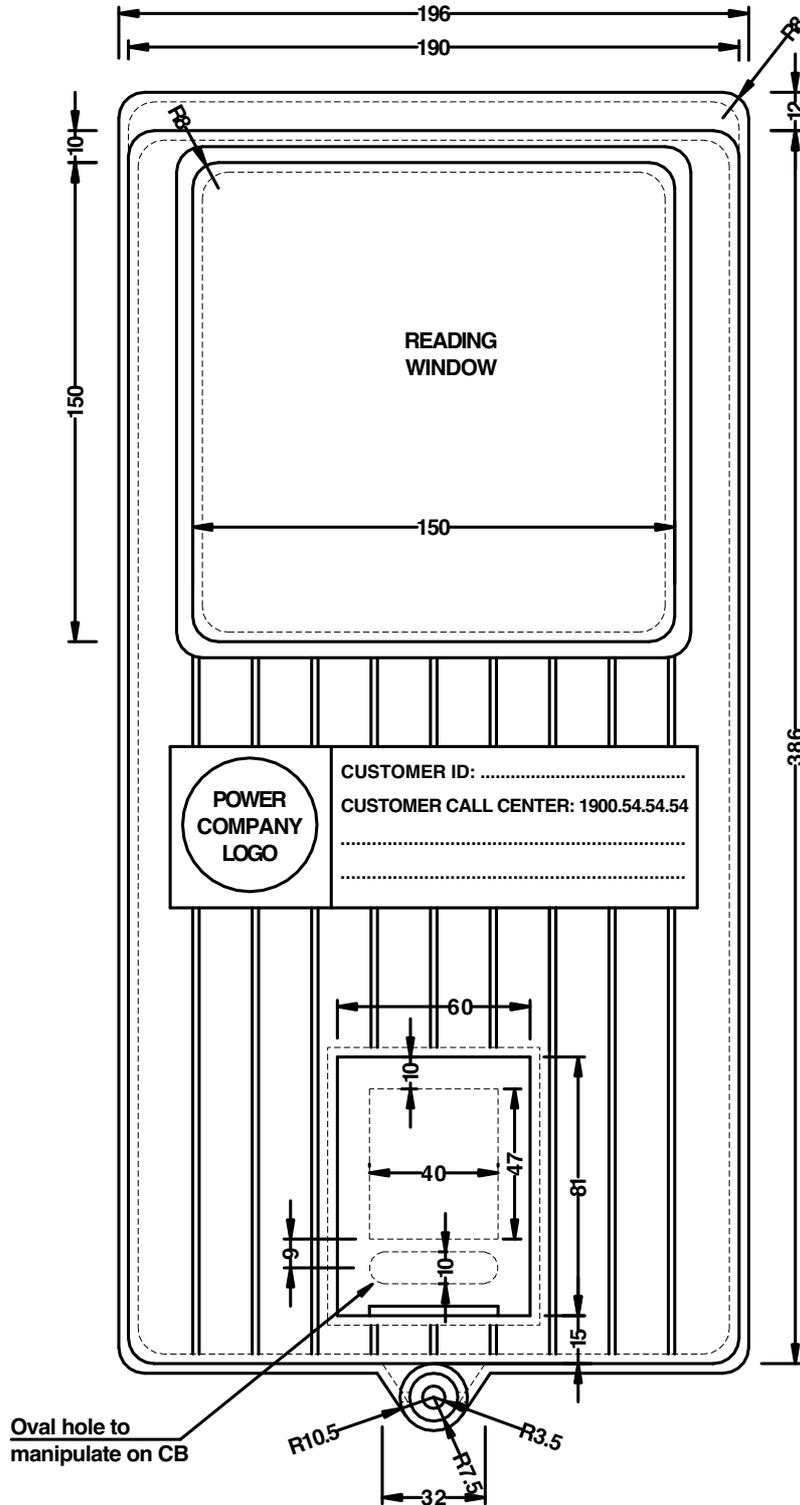
- The present activated tariff.
- Date, month, year and present time. Format of date and time: dd-mm-yy and hh:mm:ss.
- Multiplier factor
- Phase sequence
- Indicate the quarter quadrant of working load
- Counts of programming and the last time of programming
- Recording and warning of error and events:
 - Three phase meter: reverse power, phase voltage error, phase current reversed, overcurrent, over voltage, voltage drop, out of battery, incorrect phase sequence, and hardware failure of meter. The events are recorded in meter along with the time occur.
- Communication:
 - The meter can be programmed through optical bidirectional port complied with the IEC 62056-21 and minimum data transmission speed is 2400bps. The optical port shall be on the surface of meter, using infrared signals, can be connected to external optical devices into meter safely.
 - The meters have a detachable communication module to transmit data from meters to Head End System (or vice versa) by using GPRS or 3G technology.
 - Data transmission rates at minimum is: 1200 bps
 - The signal interface and data access protocol shall be provided and detail described by the manufacturer.
- Additional requirements of communication module:
 - The transmission technology will change when changing the module.
 - The module must be powered by the meter power supply.
 - The module must operate stably and has compact size, small power consumption, and high anti-disturbance ability.
 - ~~GPRS/3G antenna shall be easy removable.~~
 - Communication module shall have a built-in protection against unwanted access. Access from which communication is allowed is entered as a parameter in the communication module.
 - ~~The communication module has to be equipped with a function to maintain the communication channel active even if the equipment has not been used for a longer time (this time represents a parameter).~~
 - The communication module must be installed inside the meter at a place so that when need to inspect or replace it, operator don't remove the testing sealed

leads of the meter. The connectors and cables of communication module are under the responsibility of the supplier.

- Meter programming software:
 - The meter shall allow local and remote setting.
 - The software must enable full programming, backup and retrieve the measuring data of the meter and events from the meter.
 - The any new release of the software can be used to program for the meters that previously purchased.
 - Configuration files from older software version shall be operable in any newer versions
 - The software must enable to export the metering data, events and configurations from the meters to text files (.TXT, .CSV, .XML) with a database structure
 - Allow resetting value of the cumulative energy registers and energy under tariff register return “0” value by using level 3 password combined with impacting on the hardware component located inside the meter.
 - When configuring parameters of the meter, the meter do not stopping and affect to meter's metrology.
 - Operating in Windows 7 or latest versions.

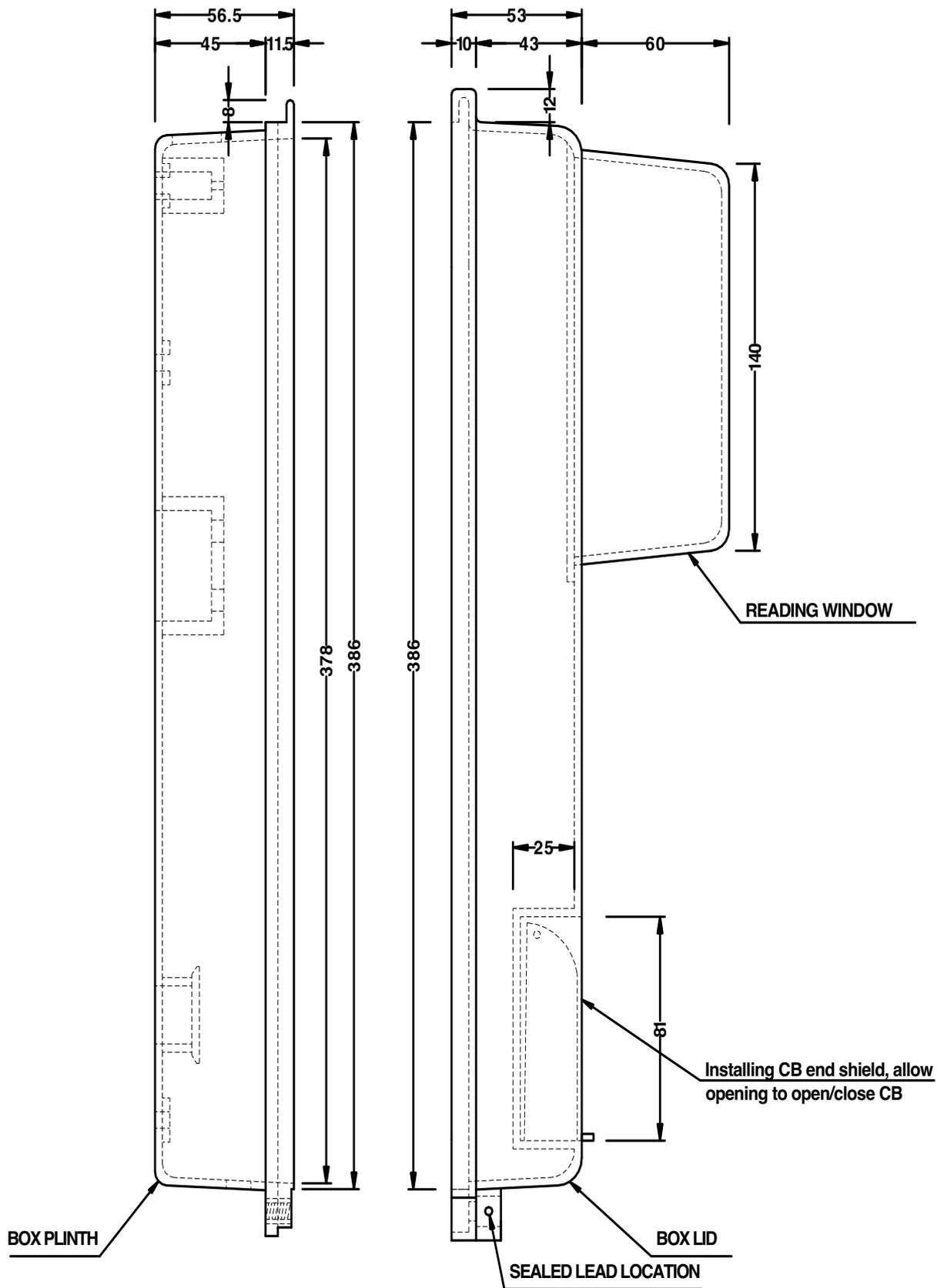
APPENDIX 2.1 – Existing Meter Box Dimension

A. SINGLE PHASE METER BOX

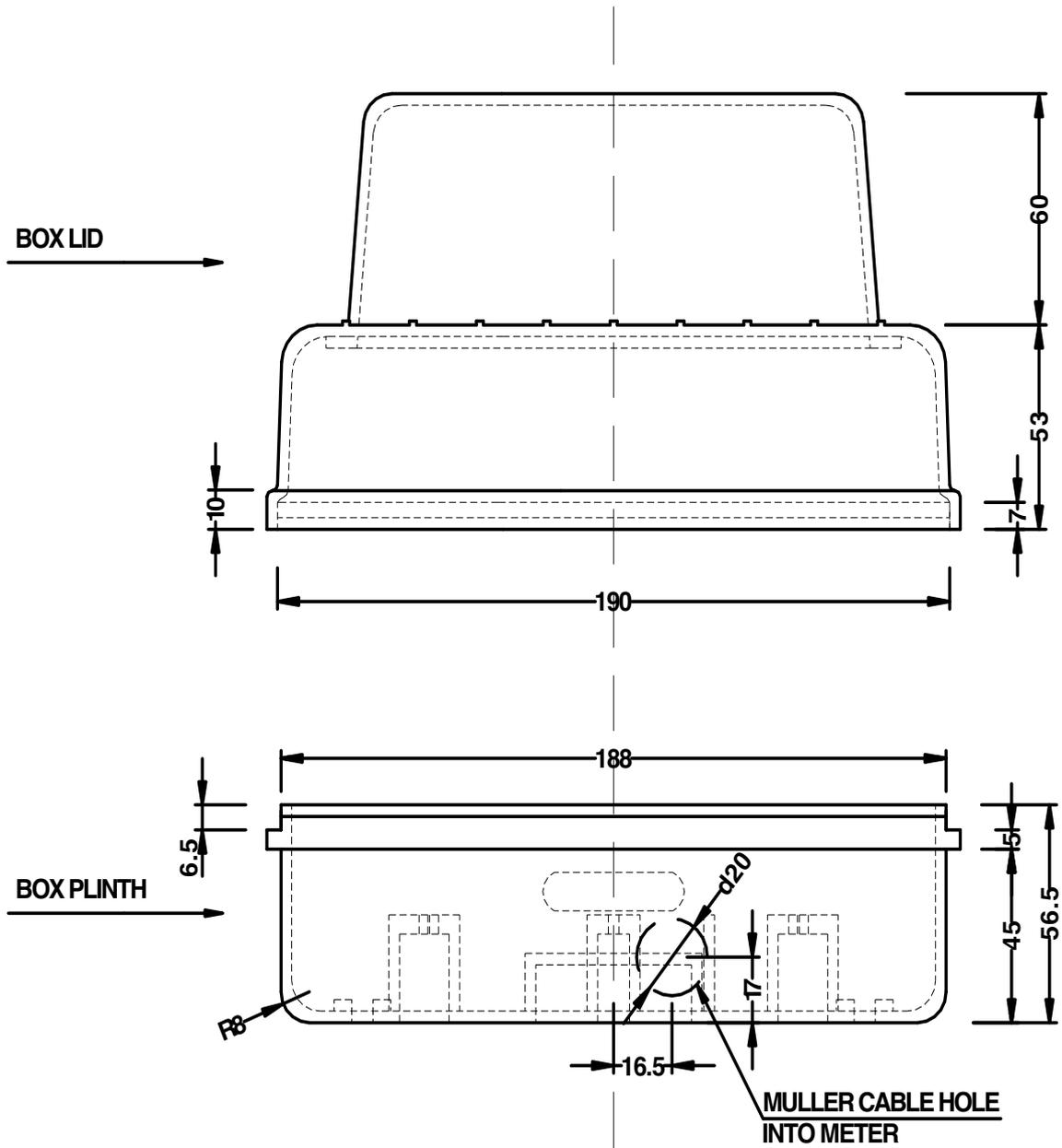


CONTENT	PARAMETER
MATERIAL	Plastic or plastic reinforced fiber-glass
THICKNESS	min 4mm

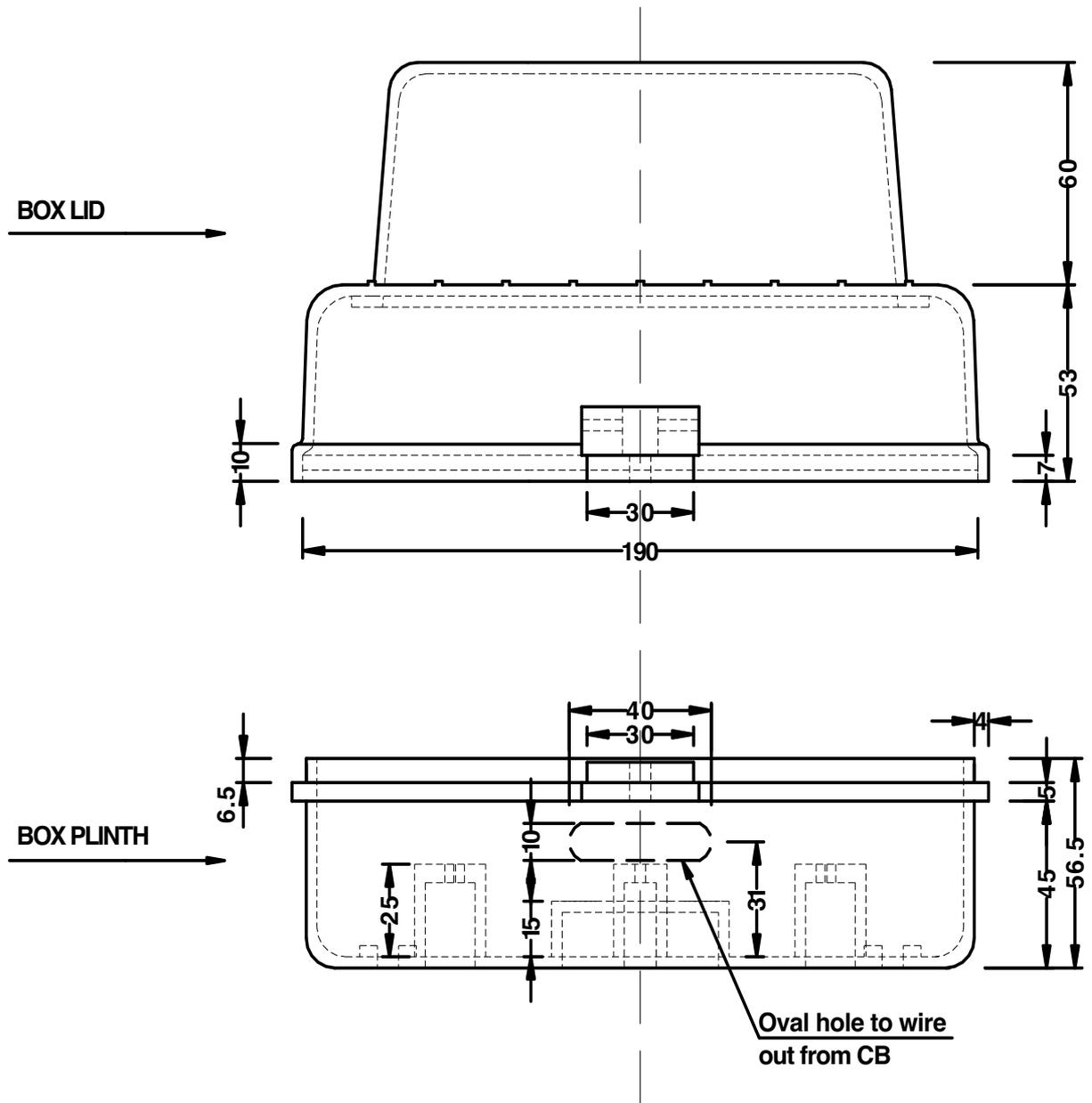
INDOOR MOUNTING TYPE - FRONT VIEW



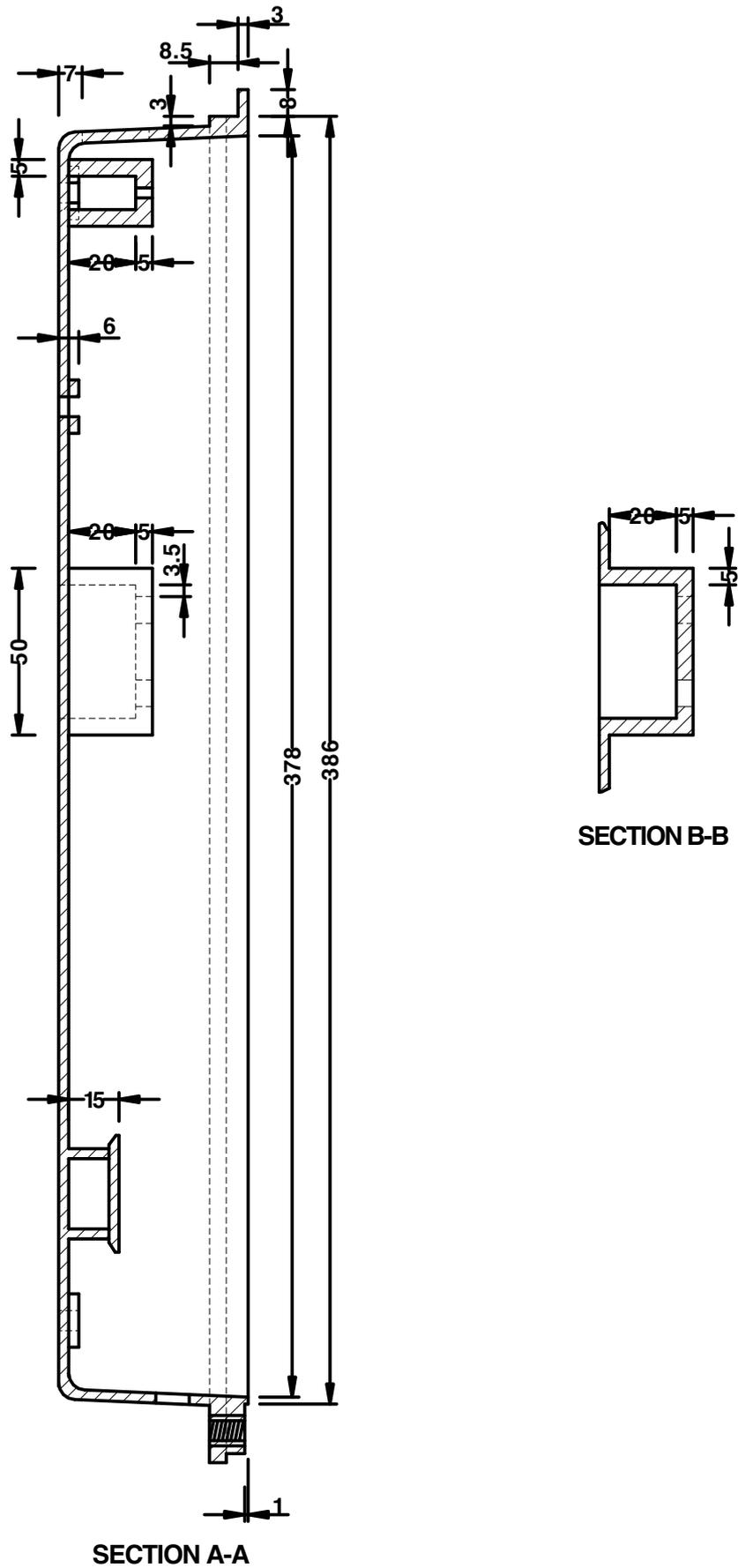
INDOOR MOUNTING TYPE - SIDE VIEW



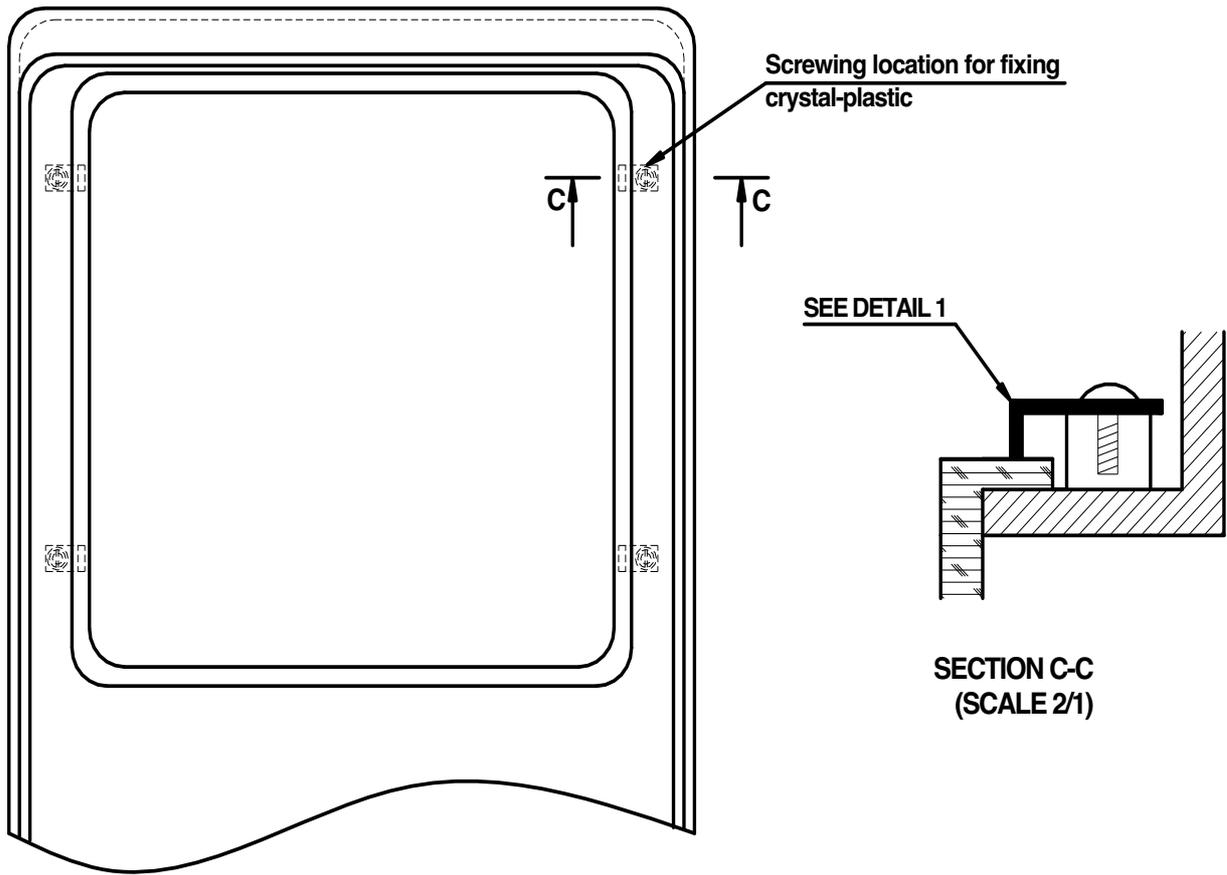
INDOOR MOUNTING TYPE - TOP VIEW



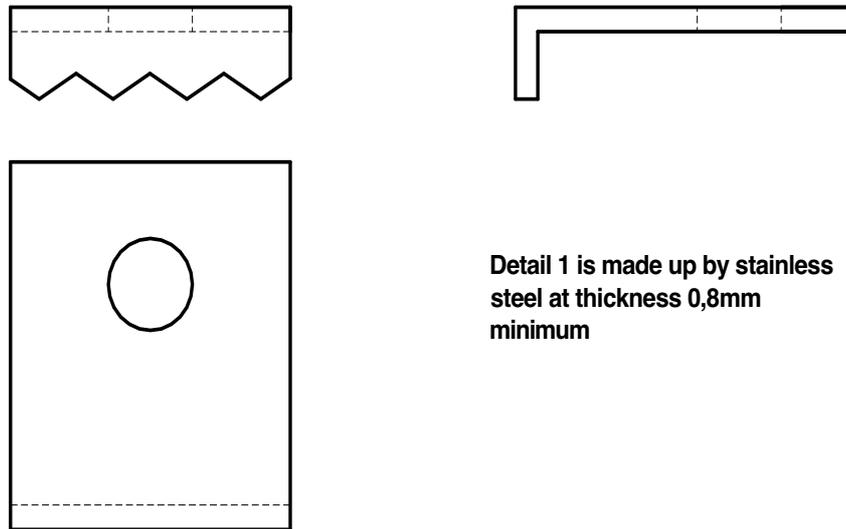
INDOOR MOUNTING TYPE - BOTTOM VIEW



INDOOR MOUNTING TYPE - BOX PLINTH



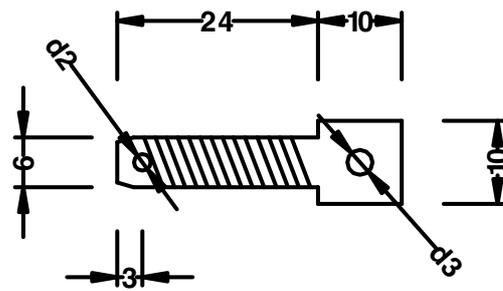
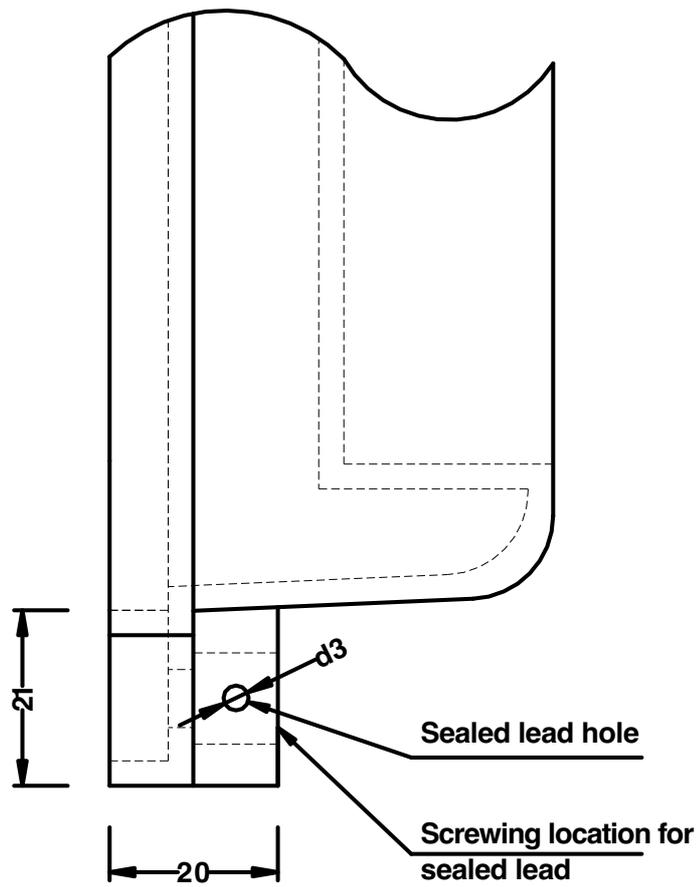
INSIDE OF BOX LID



Detail 1 is made up by stainless steel at thickness 0,8mm minimum

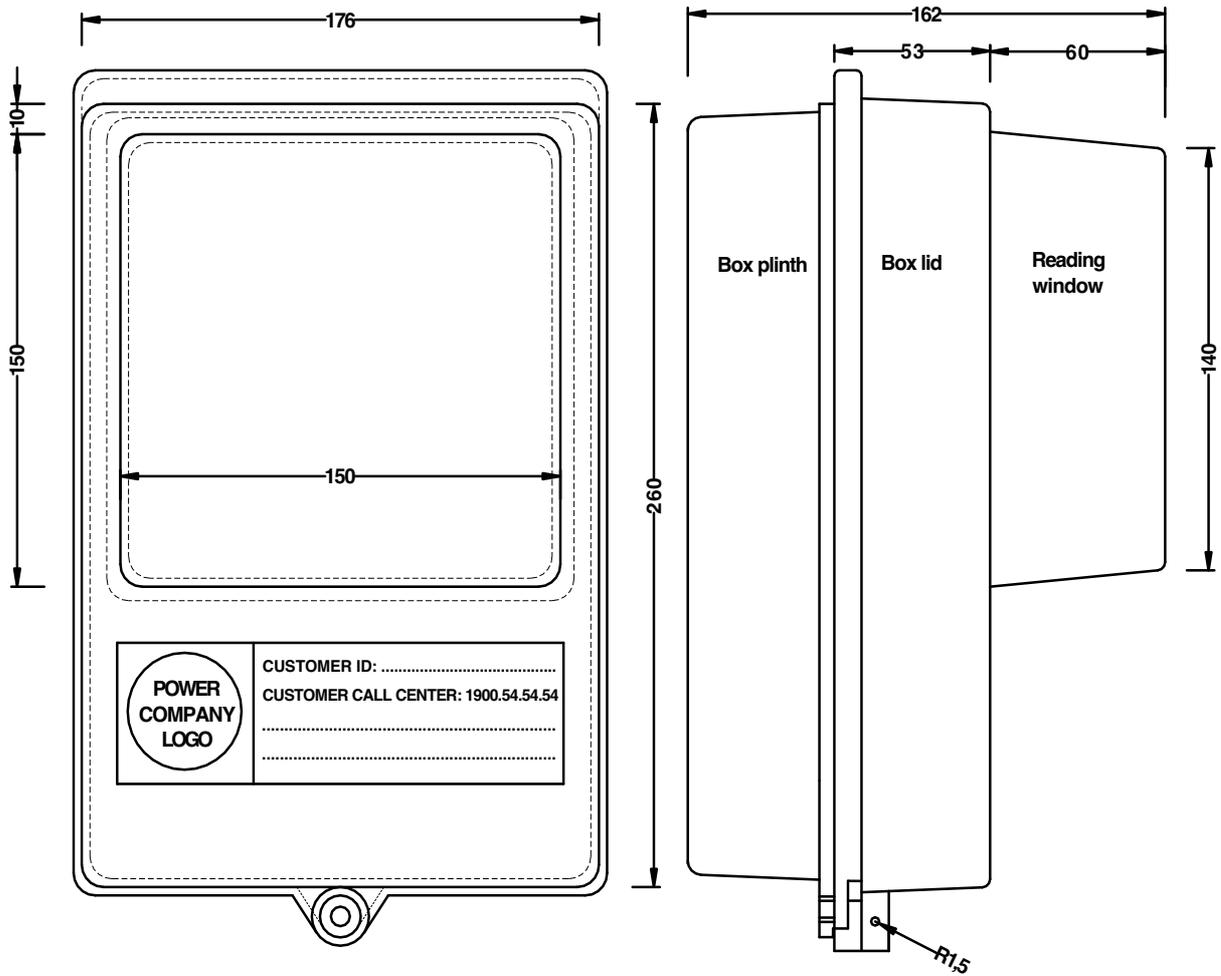
DETAIL 1 (SCALE 4/1)

INDOOR MOUNTING TYPE - READING INDICATOR



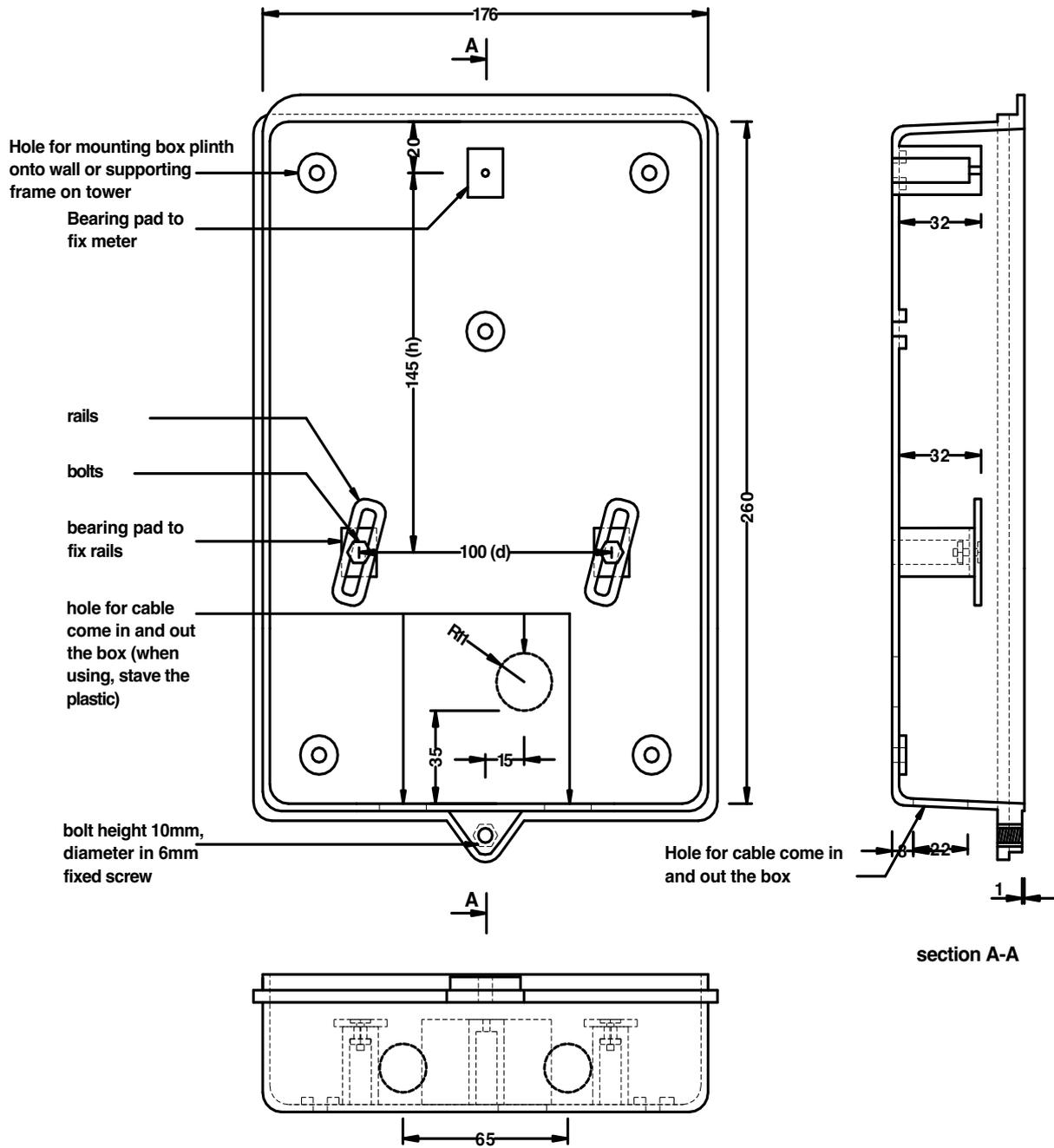
Screw connect box lid
to box plinth and
sealed lead

INDOOR MOUNTING TYPE - LOCATION FOR SCREWED UP AND SEALED LEAD



CONTENT	PARAMETER
MATERIAL	Plastic or plastic reinforced fiber-glass
THICKNESS	min 3mm

OUTDOOR MOUNTINGTYPE



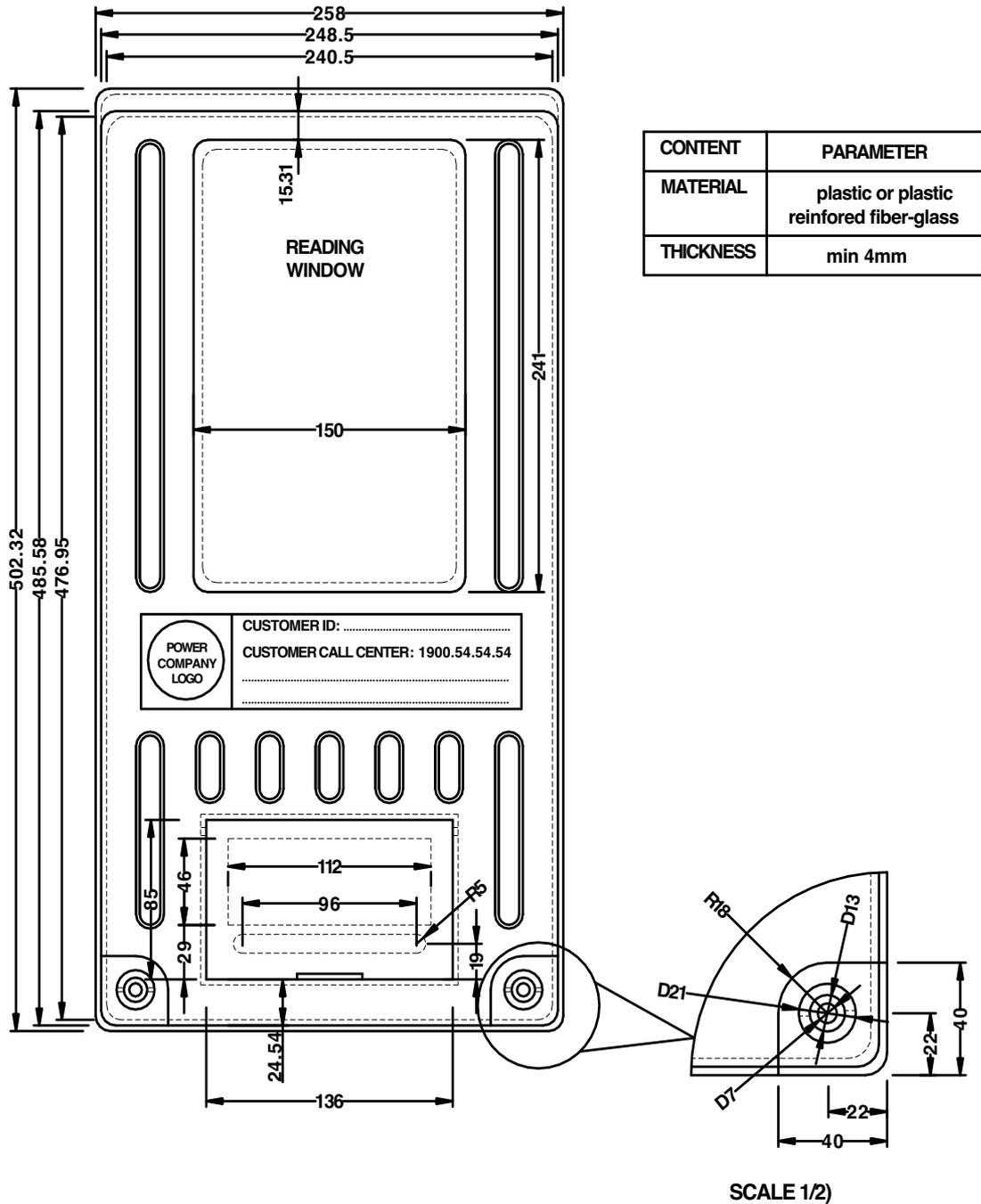
NOTE: Rails size shall meet requirement to install meter with sizes in range of $h-20, +10\text{mm}$ and $d\pm 10\text{mm}$

OUTDOOR MOUNTING TYPE - BOX PLINTH

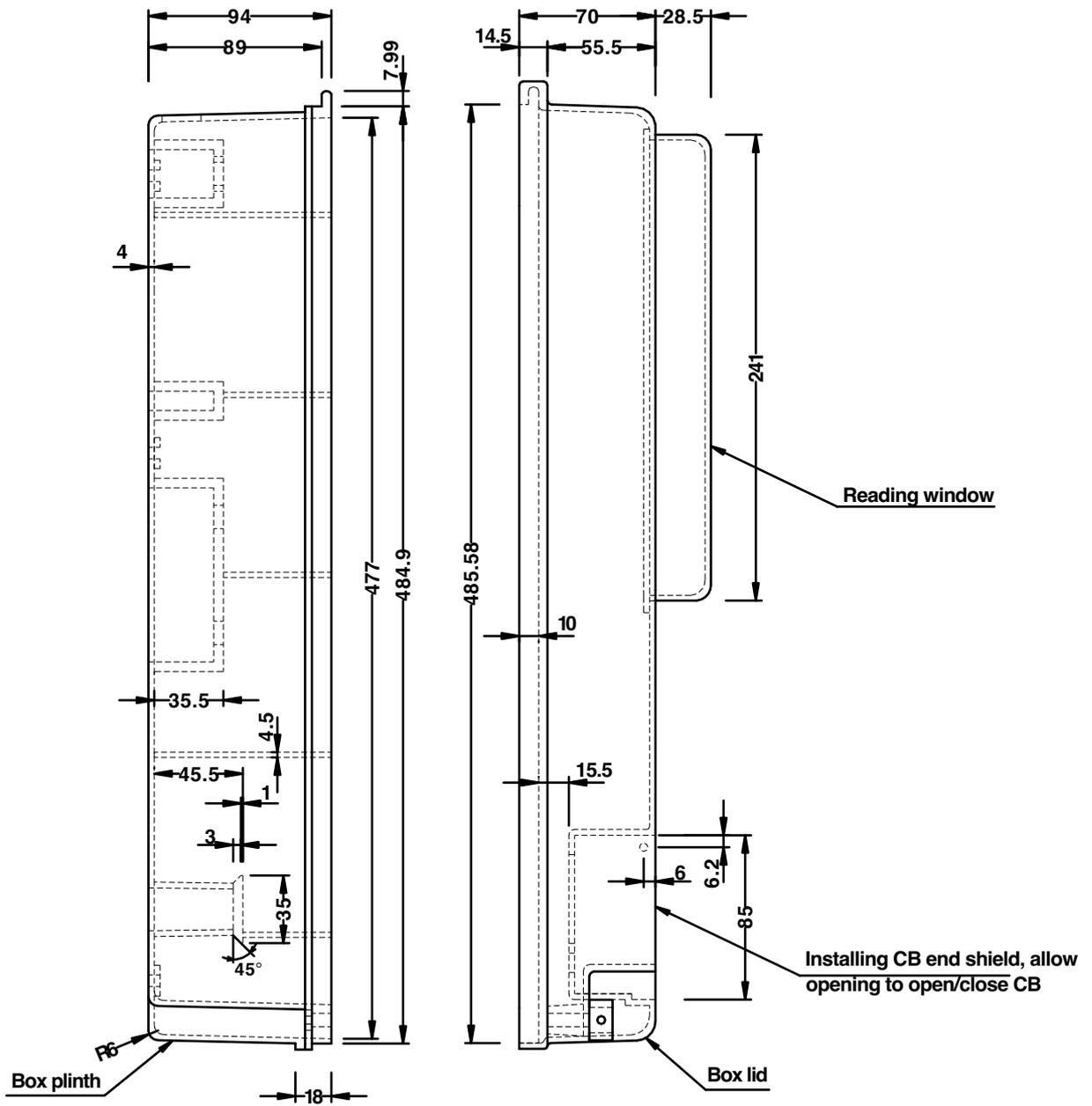
B. 3-PHASE METER BOX

No.	TYPE BOX	DISCRIPTION	PAGE REFERENCES
1	TYPE 1	Indoor meter box, using CB mounting on rail type.	Page 2, ..., 8
2	TYPE 2	Indoor meter box, using CB fixed type.	Page 9, ..., 12 and some section, detail refers to pages 4, 5, 7
3	TYPE 3	Outdoor meter box, CB mounted in customer's house.	Page 13, 14

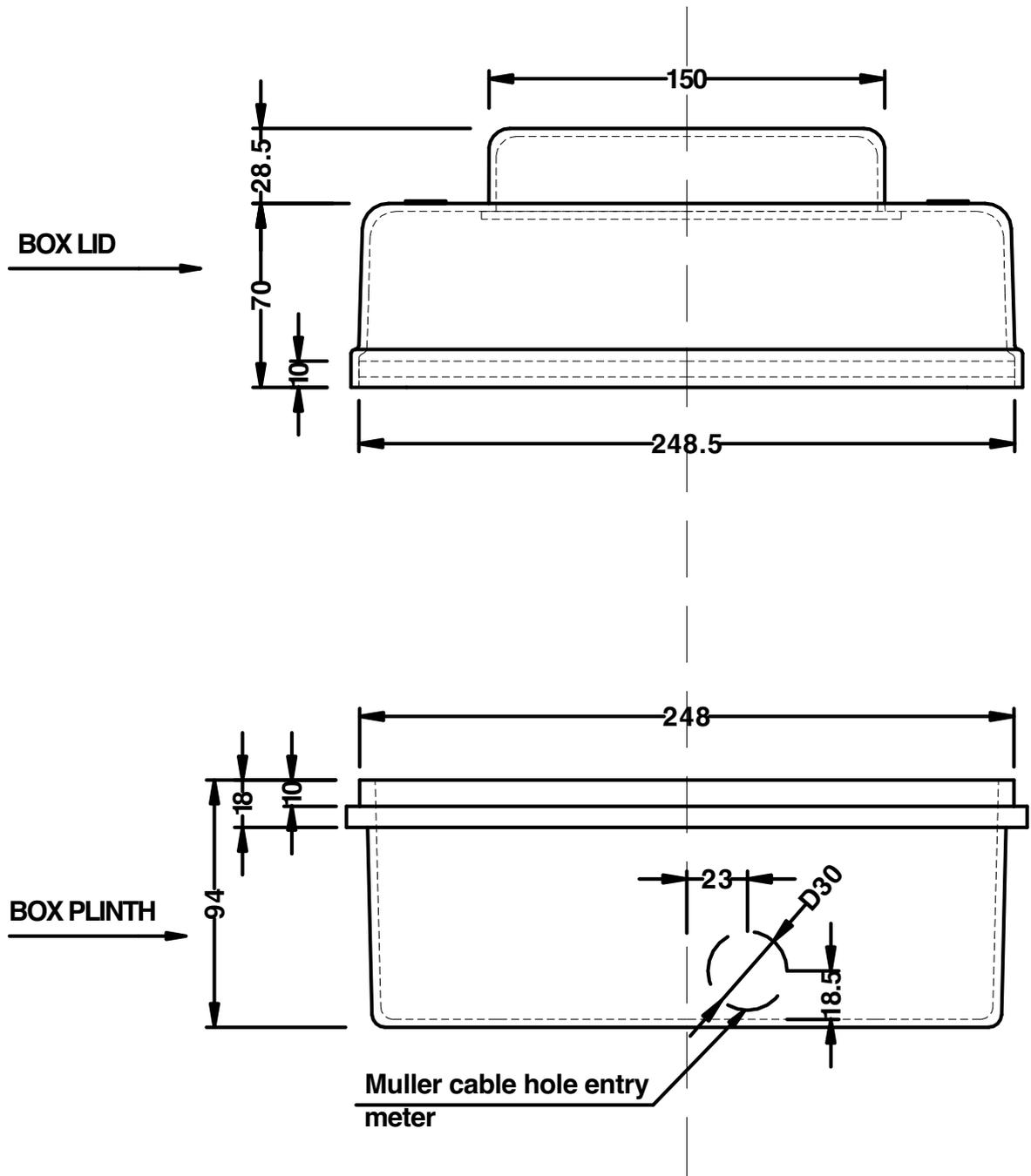
APPLICATION INSTRUCTIONS



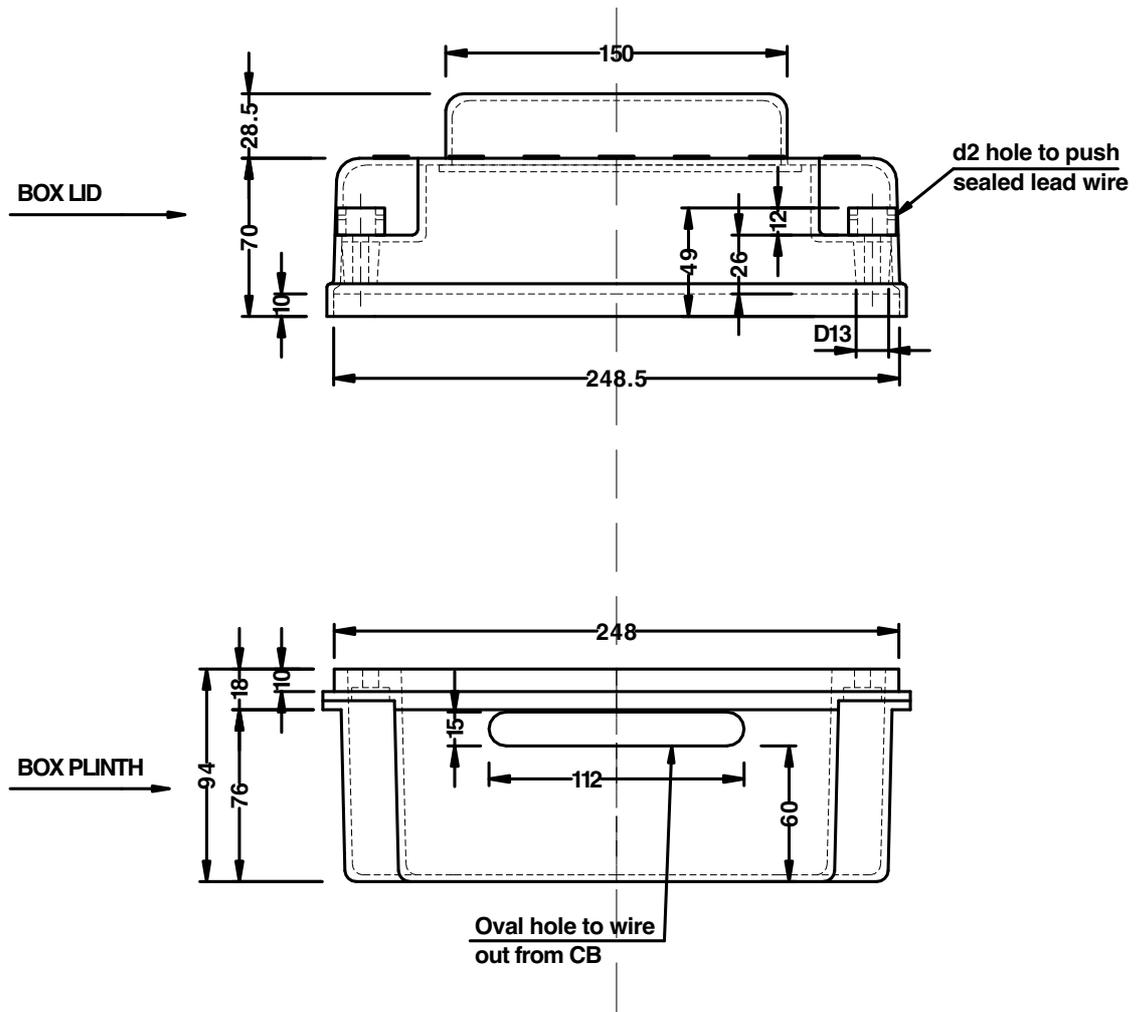
METER BOX TYPE 1 - FRONT VIEW, PAGE 2/14



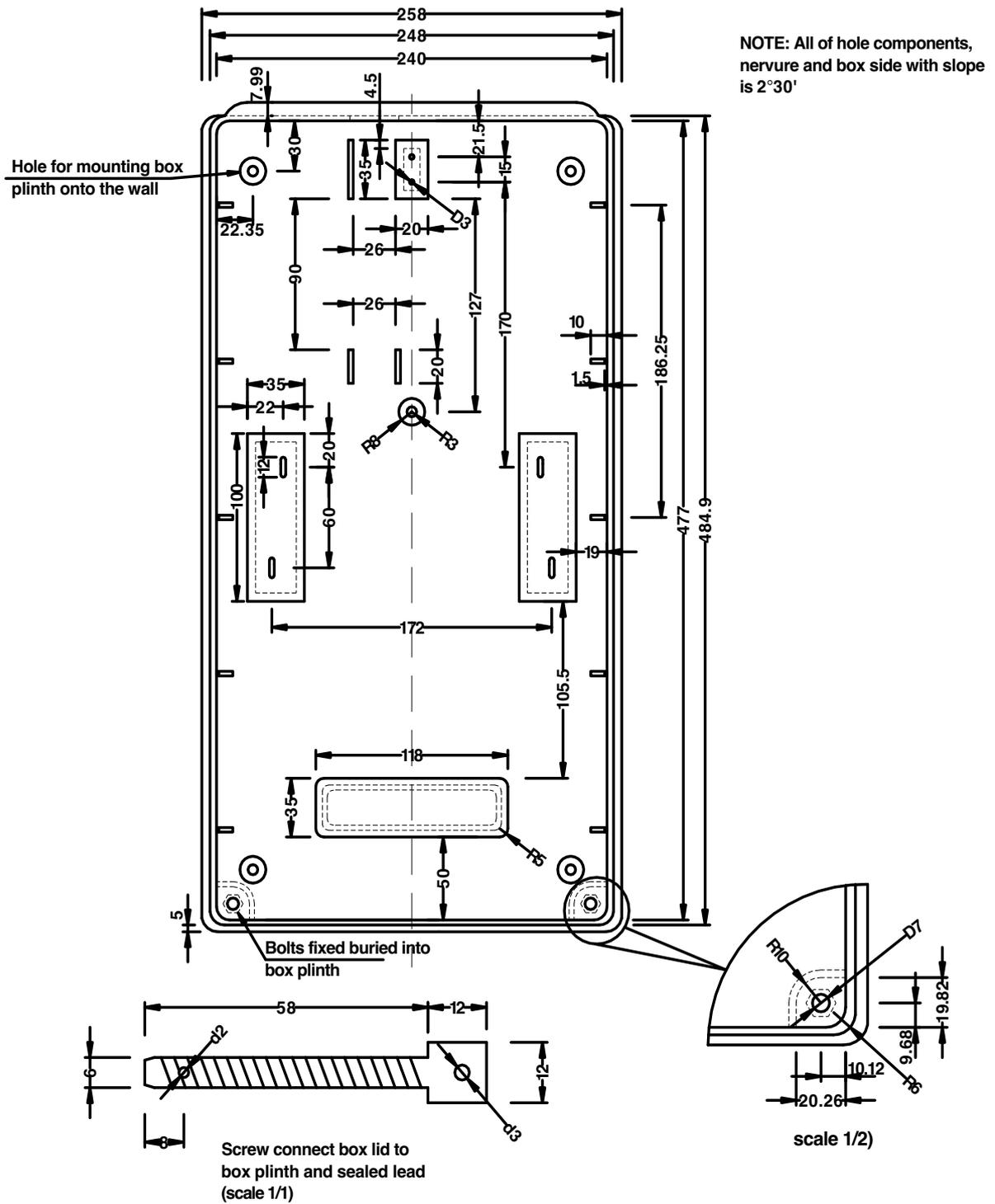
METER BOX TYPE 1 - SIDE VIEW, PAGE 3/14

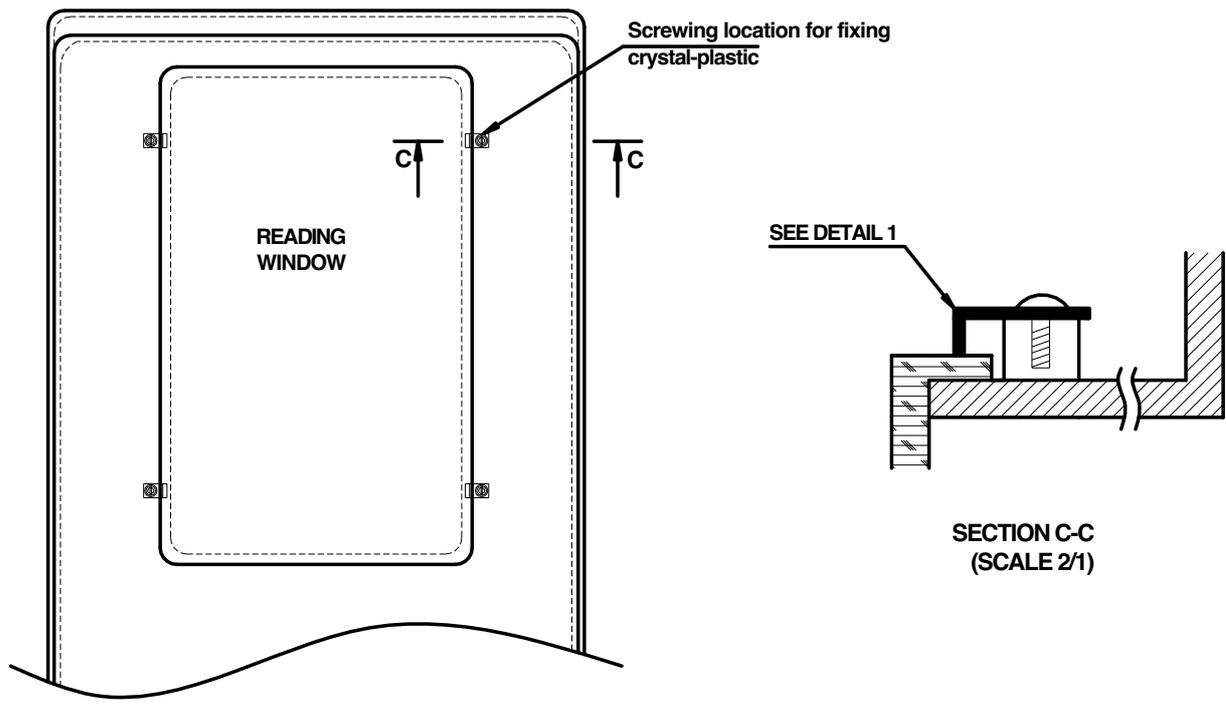


METER BOX TYPE 1 - TOP VIEW

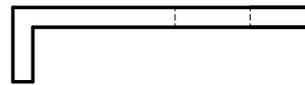
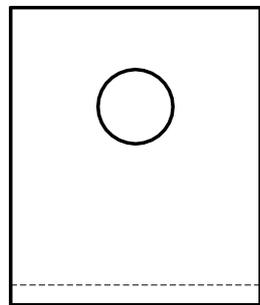
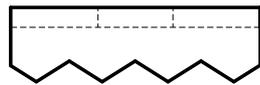


METER BOX TYPE 1 - BOTTOM VIEW





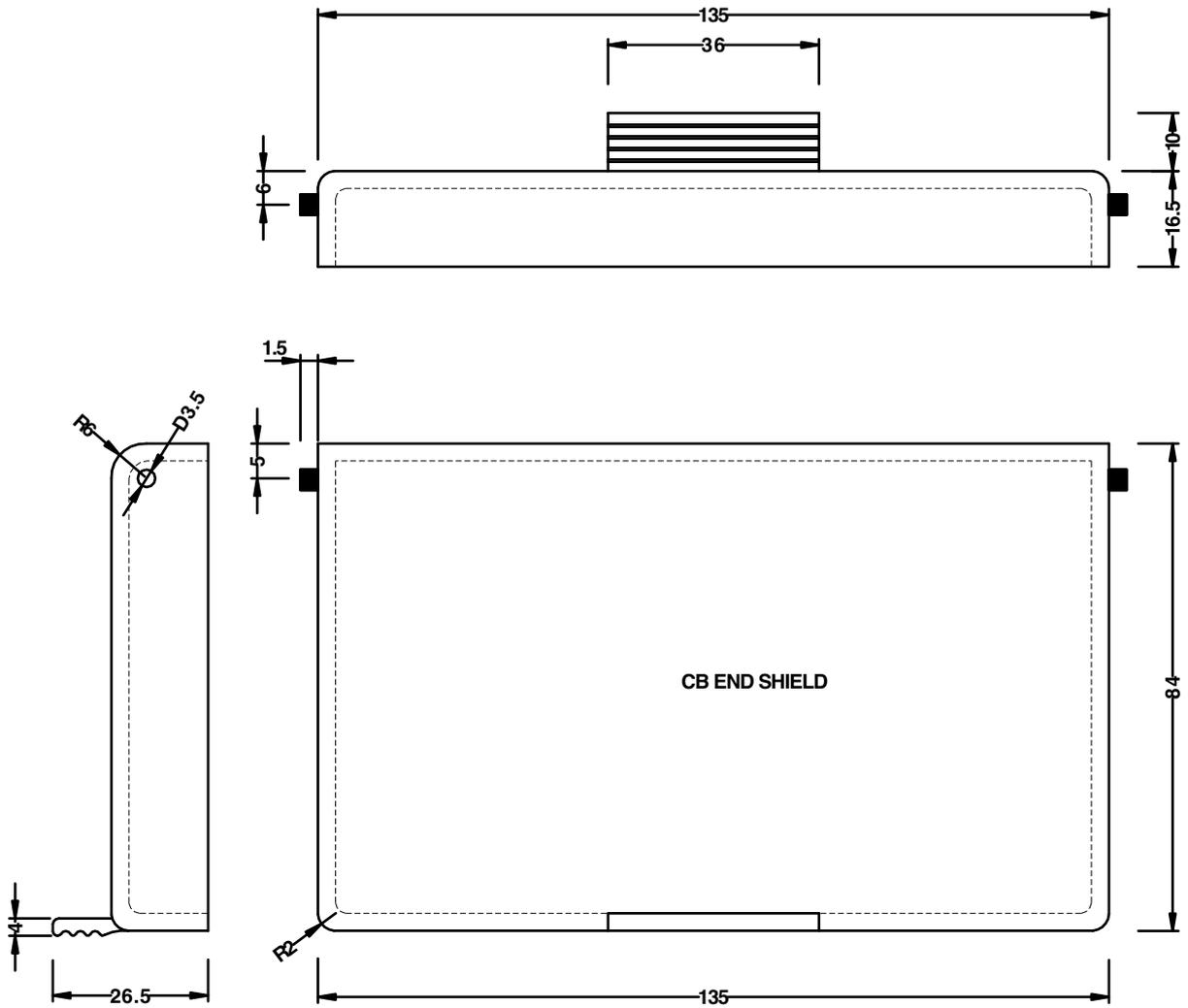
INSIDE BOX LID



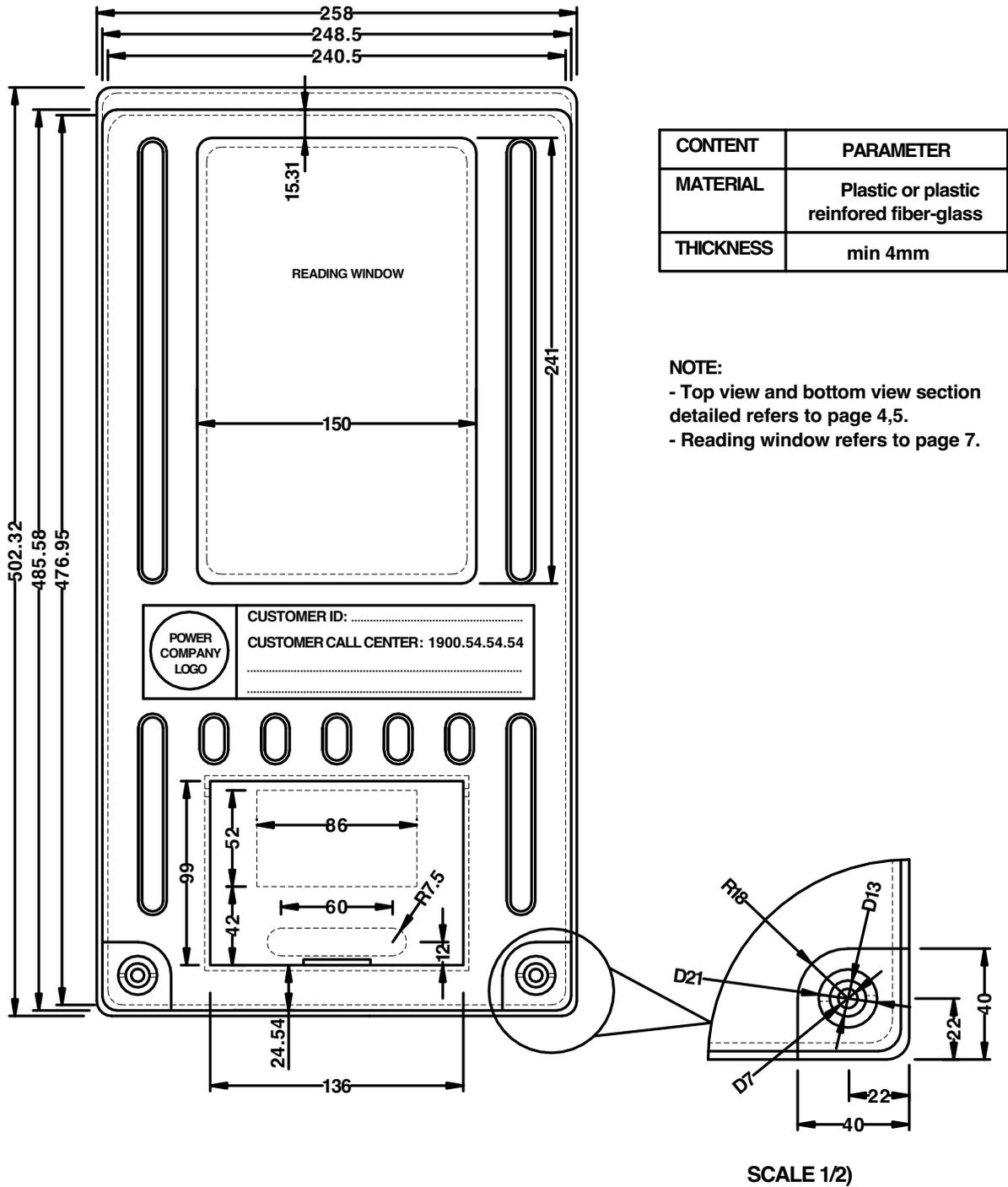
Detail 1 is made up stainless steel with thickness 0,8mm minimum

DETAIL 1 (SCALE 4/1)

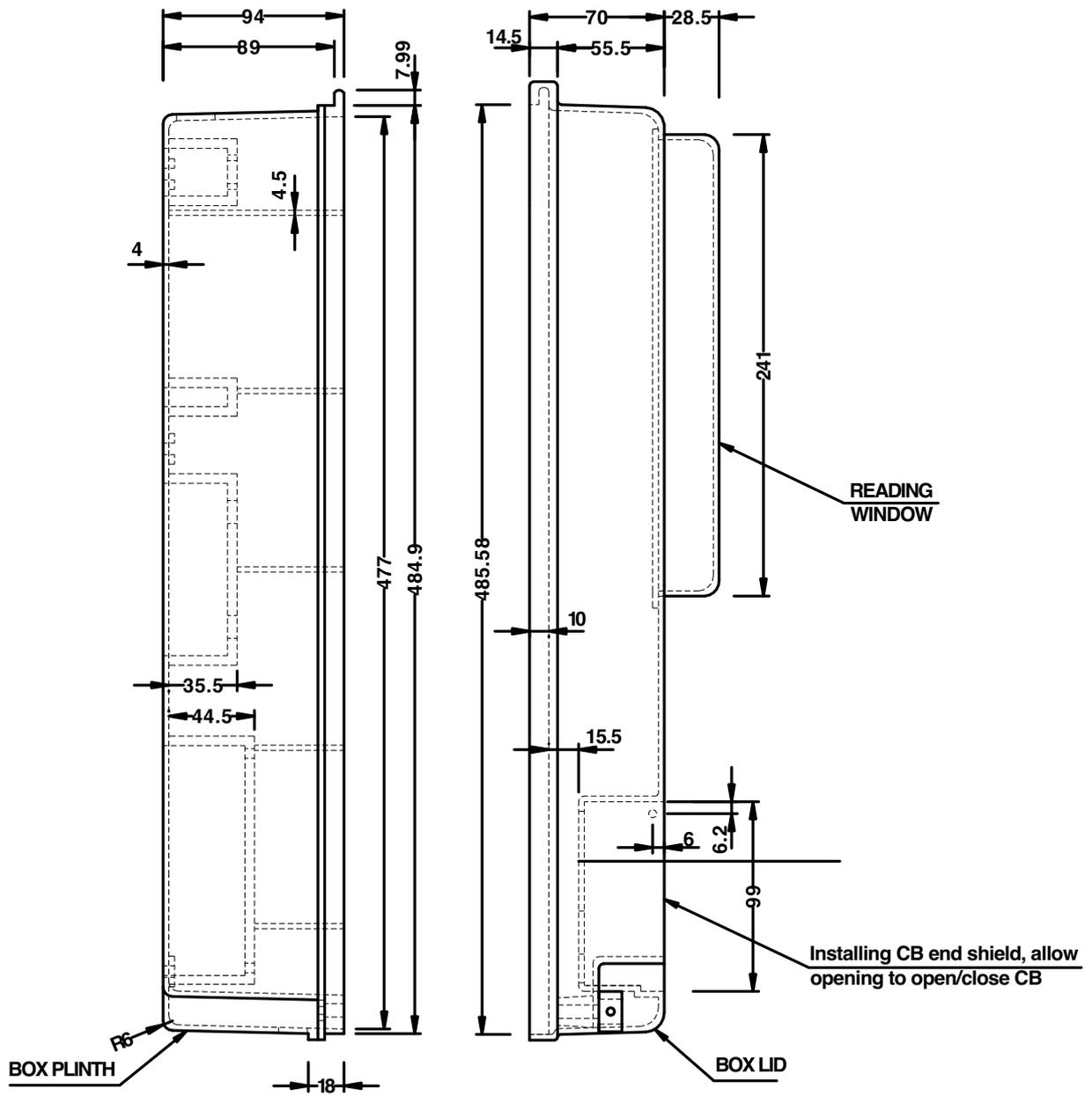
METER BOX TYPE 1 - READING WINDOW, PAGE 7/14



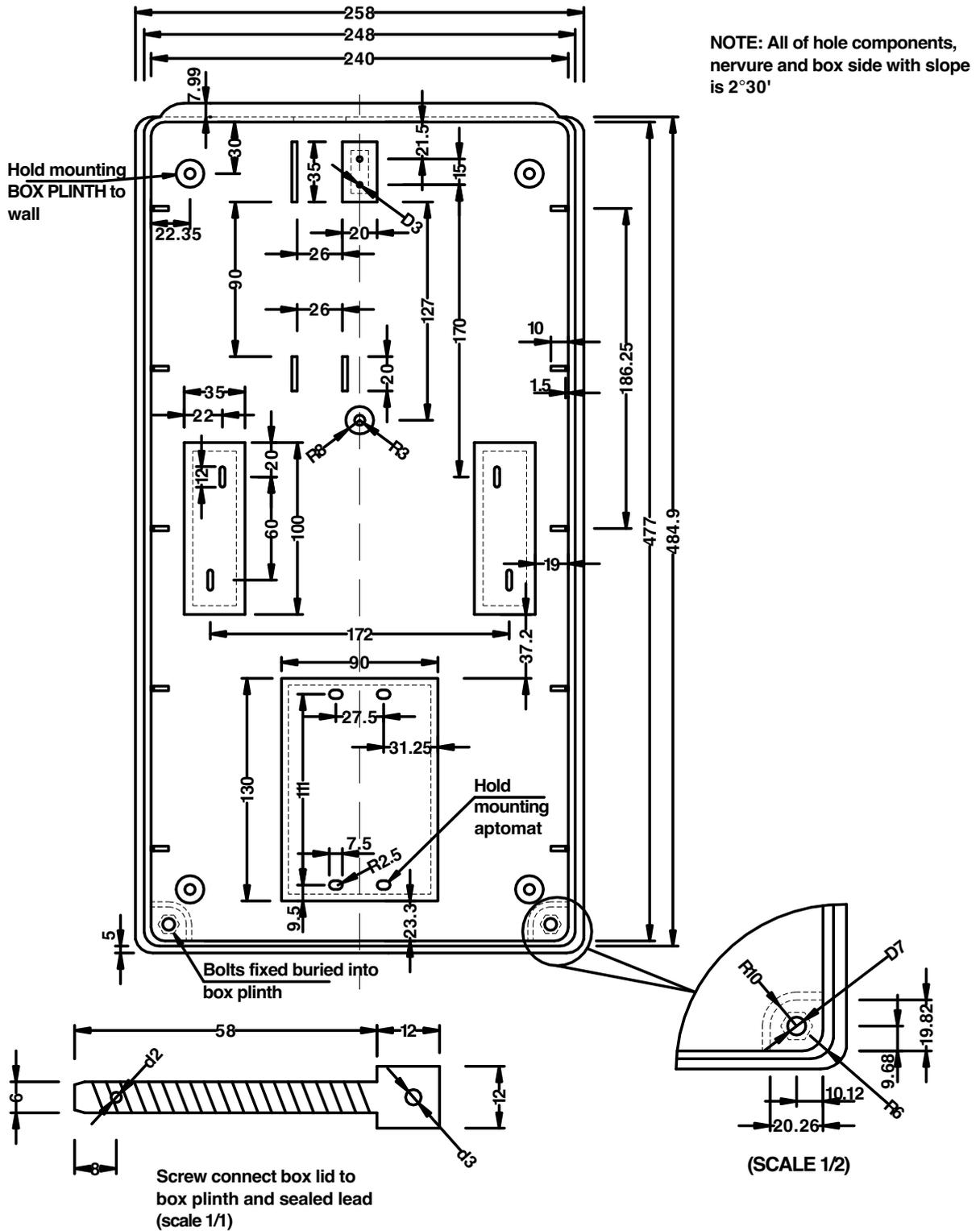
METER BOX TYPE 1 - CB END SHIELD, PAGE 8/14

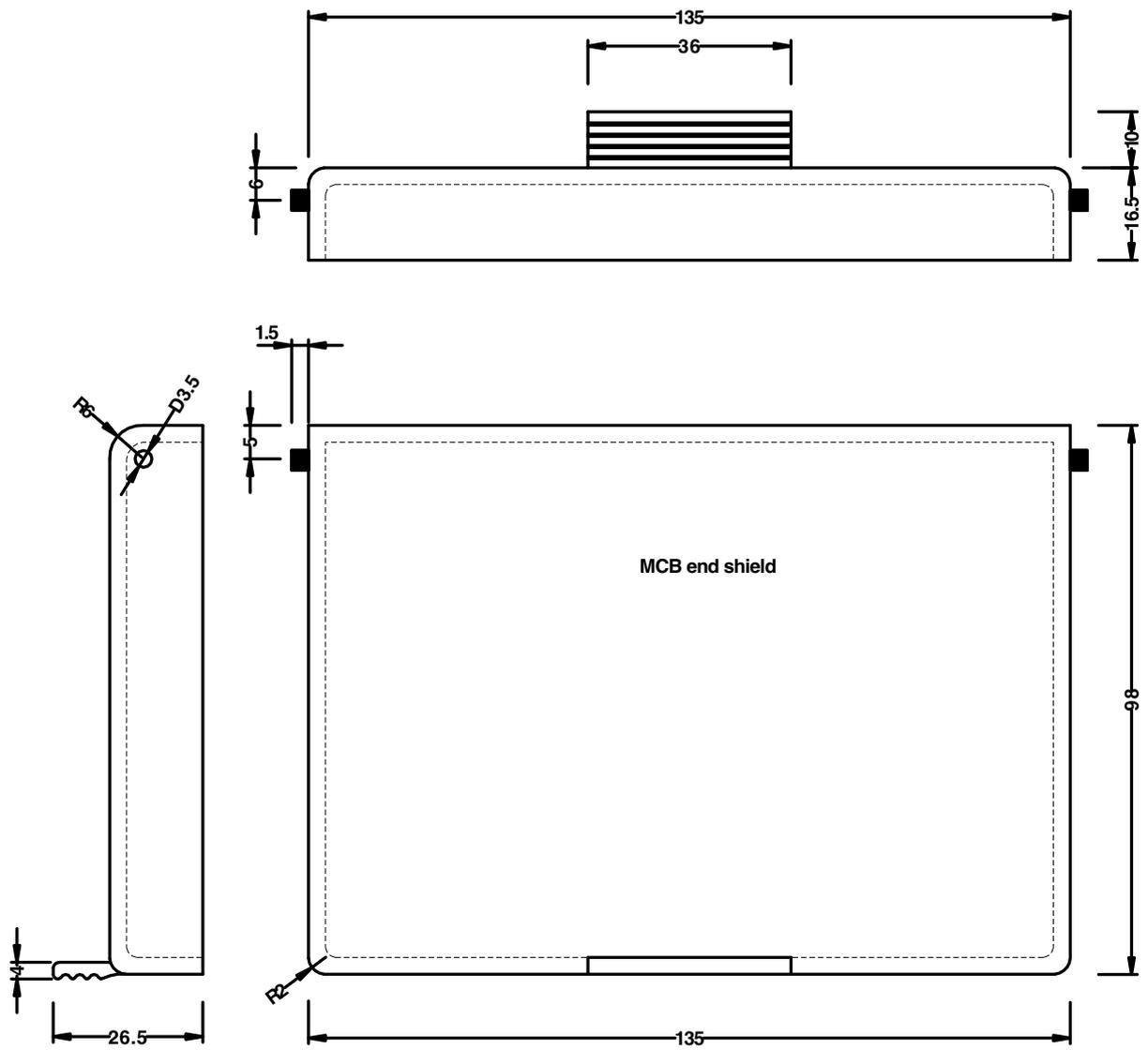


METER BOX TYPE 2 - FRONT VIEW, PAGE 9/14

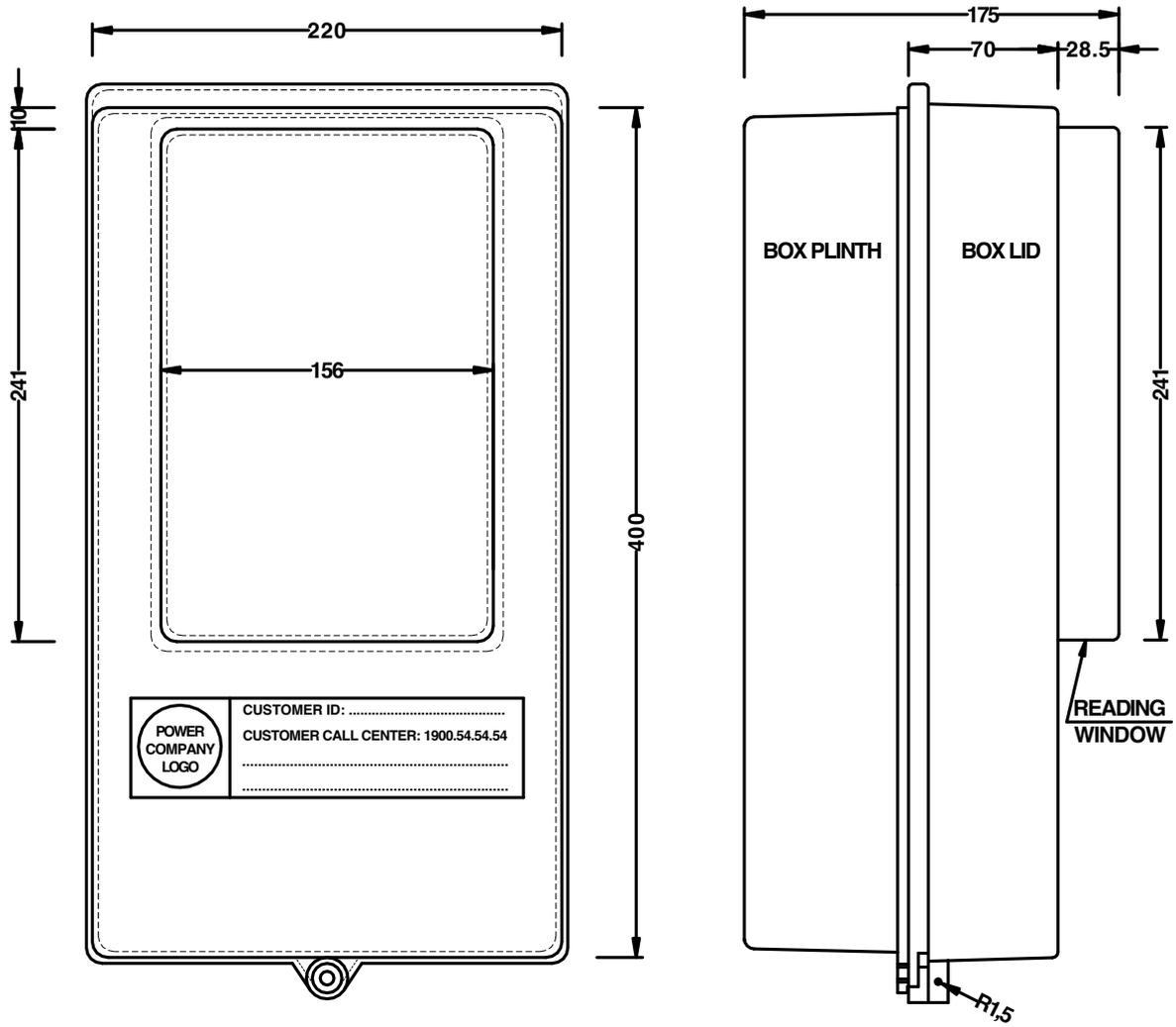


METER BOX TYPE 2 - SIDE VIEW, PAGE 10/14



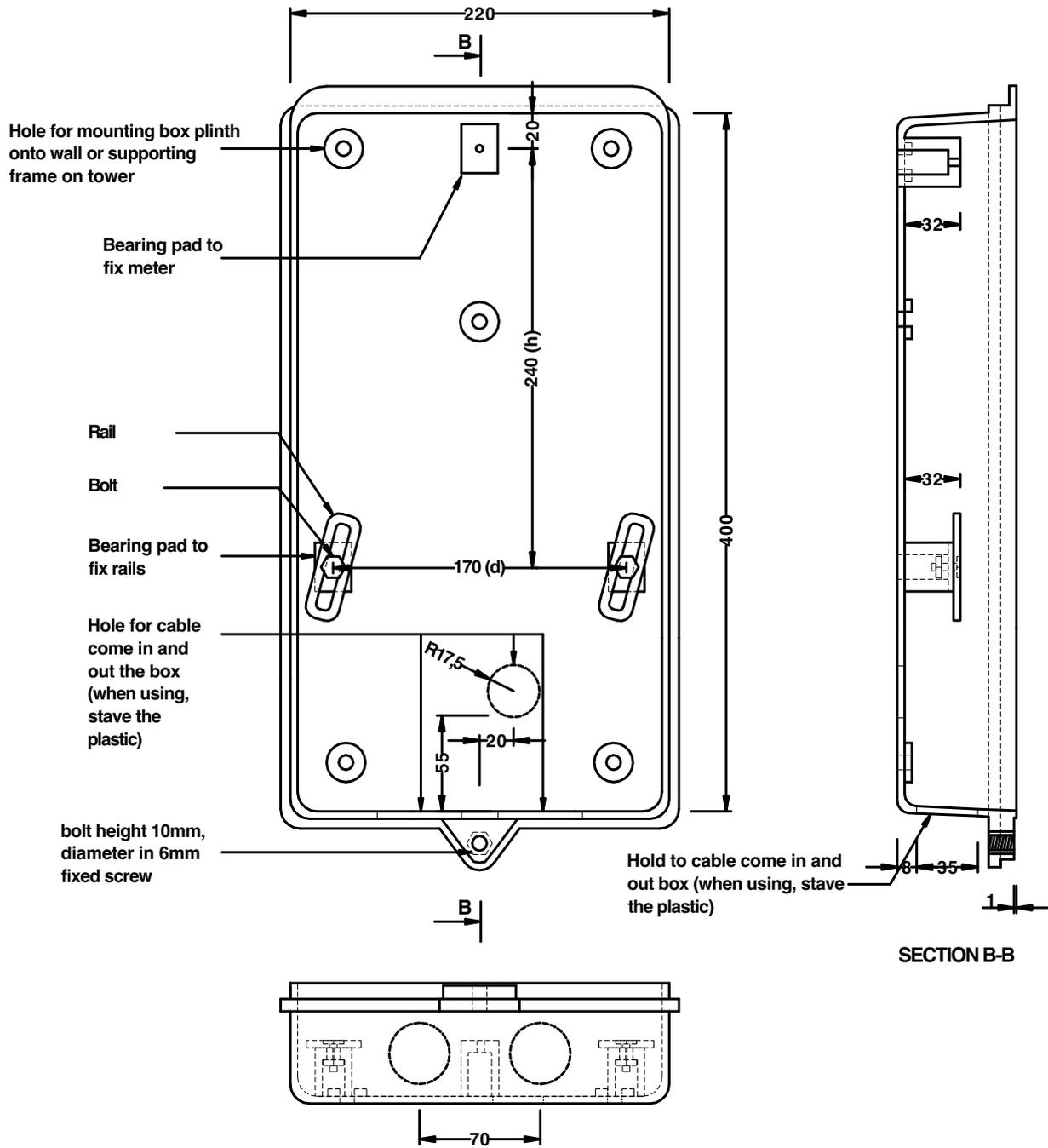


METER BOX TYPE 2 - MCB END SHIELD, PAGE 12/14



CONTENT	PARAMETER
MATERIAL	Plastic or plastic reinforced fiber-glass
THICKNESS	min 3mm

METER BOX TYPE 3, PAGE 13/14



NOTE: Rails size shall meet requirement to install meter with sizes in range of h-20, +10mm and d±10mm

METER BOX TYPE 3 - BOX PLINTH, PAGE 14/14

4. FUNCTIONAL REQUIREMENTS AND CAPACITIES OF COMMUNICATION NETWORK COMPONENTS

The Communication Components shall guarantee the reliable and fast bidirectional data transfer between AMR components. Technical solution for data transfer shall be such to have a capacity sufficient for AMR components to perform all the set tasks within specified times. Also, shall provide a corresponding code protection of transferring data (e.g. Protection against unauthorized reading, unauthorized command generation, ill-intentioned submission of false data, etc.).

4.1. Technical Requirements and Main Functionalities Of The Communication Network For Direct Meter

The communication infrastructure of AMR system for a high number of customers is oriented to provide to the Electric utilities their own telecommunication infrastructure trying to reduce the third party telecommunication services. There are three models of network widely deployed: Network based on RF mesh technology, Network based on PLC technology and Network based on a mixed RF mesh - PLC technology. The following section will describe the general requirements to be met by any of them.

4.1.1. Scope of the Supply

- The Supplier shall be responsible for providing the communication network between the meter and the HES.
- The installation and configuration of the data concentrator or any other communication equipment shall be the sole responsibility of the Supplier;
- All communication equipment or facilities that will be installed across the communication path (from meter to HES), such as modems and data concentrators or interface converters shall be installed by the Supplier in a secure way and it is responsible for all cost associated with this installation.
- All equipment that will be installed at Main and Backup sites shall be mountable inside of customer Racks. If the Employer does not have space available, the Supplier shall supply a rack of the same characteristic of those that Employer already have.
- The Communication Infrastructure shall be scalable. Assured the features required in this Specification, for the expansion of the remote points, the HES shall ensure the scalability to meet up with all utility low consumption customers.
- Communication route with the meter shall be registered and shall be able to be requested at any moment from HES.
- Communication function with meters needs to support a fully automated repetition procedure and finding of the optimal communication path.
- Communication function has to offer information online quality such as signal/noise ratio, attenuation and data loss statistics for all its components.

4.1.2. System Performance (Data Communication)

In accordance with a selected architecture and selection of communication technologies, the system shall be in the capacity to provide a minimum of characteristics.

- **Reading success of metered (registered) value in given time frames**

Single phase and 3-phase, single-tariff: The System shall be capable of providing daily active energy (kWh) for the utilities total meters in the project inventory with over 99% or better success rate in a normal Gap between 12 a.m. and 8 a.m.

Single phase and 3-phase, multi-tariff: The System shall be capable of providing daily alarms, active and reactive energy (kWh and kVARh), peak active power (kW) and voltage, current, power factor for the utilities total meters in the project inventory with over 99% or better success rate in a normal Gap between 12 a.m. and 8 a.m.

The System shall be capable of providing at least one channel of hourly interval data from the utilities total meters in the project with over a 95% or better success rate in a normal Gap between 12 a.m. and 8a.m.

- **Reliability of data transfer**

The reliability of data transfer will be considered in function of the first time read success. The supplier shall show number consistently in the 92% range of successful read in the first attempt. With three retries, the system shall achieve routinely over 99% successes.

The System shall have a data transmission system with automatic mechanism for retransmission and control of delivery;

The Supplier shall warrant a maximum system failure of three times per year.

- **System response speed (response time to the command given to System component)**

The System response Time for a command to demand of daily consumption read shall be between 20 to 30 seconds.

- **Failure intensity of Communication system components**

The System communication Component Failure rate shall be $\leq 0,25\%$ annually.

- **Operation life of Communication System components**

The Communication Component Operation life shall be 15 years.

4.1.3. System Performance Warranty (Data Communication)

In complete production and operation, the System shall provide the following efficiencies:

- 99% of all daily values
- 95% of all hourly values
- 3 total system failures per year
- 4 hours maximum recover time when the failure is corrected

The Supplier is responsible for all the investments for these requirements.

4.2. Specific Requirements Of The Communication Network For Indirect Meters

For the communication Infrastructure of AMR system for indirect meters, the communication technology is based on cellular network (GPRS/3G) or optical network.

The Supplier shall be responsible for providing the communication services between the meter and the HES during testing implementation.

4.2.1. System Performance (Data Communication)

In accordance with a selected architecture and selection of communication technologies, the system shall be in the capacity to provide a minimum of characteristics.

• Reading success of metered (registered) value in a given time frame

The System shall be capable of providing the meter data with over 99% or better success rate for the total meters in the project in a normal Gap of 4 hours.

The system shall support at least 30-minute interval data, load profile, meter registers and events log.

The events, alarms (such as loss power for each phase) occur on the meter shall be sent immediately to HES.

• Reliability of data transfer

The Reliability of data transfer will be considered in function of the first time read success. The supplier shall show number consistently in the 90%-95% range of successful read in the first attempt. With retries, the system shall achieve routinely over 99% successes.

The System shall have a data transmission system with automatic mechanism for retransmission and control of delivery;

The supplier shall warrant network service availability over 99.7% per year

• System response speed (response time to the command given to System component)

The System response Time for a command to demand of daily consumption read TOU, voltage, current, power factor, F, shall be between 4 to 5 minutes.

• Failure intensity of Communication system components

The System communication Component Failure rate shall be $\leq 0,25\%$ annually.

• Operation life of Communication System components

The Communication Component Operation life shall be 15 years.

4.2.2. System Performance Warranty (Data Communication)

In complete production and operation, the System shall provide the following efficiencies:

- 99% for all daily reads
- 3 total system failures per year
- 4 hours maximum recover time when the failure is corrected

The Supplier is responsible for all the investments for these requirements.

4.3. Functional Requirements of Data Concentrator

~~The different technologies available are using communication data Concentrator as part of the communication Path.~~

Data Concentrators are autonomous devices executing automatically or on request the functions of meter reading and parameterization and delivery of read data to Head-end system (HES).

4.3.1. Scope

~~The data concentrator manufacturing and assembly shall guarantee a suitable flexibility to allow product's evolutions and replacement of internal modules with equivalents for obsolescence or maintenance purposes.~~ The equipment has to operate on 220/380V power systems indifferently at a frequency of 50Hz.

4.3.2. Role

Be capable to be administrated locally (via Laptop) or remotely (from HES). **BỘ SUNG CHỨC NĂNG KẾT NỐI DCU TRONG HES.**

Be enable immediate communication with individual meters, remotely (from HES) or locally (via laptop).

~~Have the ability to connect to WAN Networks by one of the following methods: Cellular, RF mesh, DSL, Frame Relay, Broadband PLC, etc.~~

4.3.3. Applicable Norms

The standards for its application shall be specified by the Supplier.

4.3.4. Data Concentrator elements

The normal Data Concentrator and installation elements shall be specified by the Supplier.

4.3.5. Functional Requirements

The DCUs shall comply with the following functional requirements:

4.3.5.1. General

4.3.5.1.1.Meters network management

~~The DCU shall be able to manage and control all associated meters. The link between a meter and DCU does not need to be permanent. A meter can change its concentrator's ownership and in this case the DCU shall update its meter list.~~

4.3.5.1.2.Configuration and firmware updates

The configuration and firmware of DCU shall be locality and remotely upgradable and also shall support local and remote configuration and firmware updates of meters by instructions from HES.

BỔ SUNG CHỨC NĂNG UPDATE PHẦN MỀM DCU TỪ HES.

4.3.5.1.3. Multi-meters capability

The DCU shall support no less than 500 meters and on-demand provides transparent mode capability (direct access to the meter, tunneling). The meter readings from a few meters located in one or closed areas shall be collected through one DCU device that will centralized all information and operations.

4.3.5.1.4. Device management and maintenance

DCU shall be remotely or locally managed and shall provide configuration do all available parameters of DCU.

4.3.5.1.5. Security

The DCU shall have security features to preclude any access of non-authorized activity and restrict performing activities that are not within authorization.

DCU shall support data protection using encryption with AES¹ 128/256 or equivalent or stronger cipher algorithm. Also it shall support authentication for communication with meters and for uplink data-transfer.

The uplink communication between DCU and HES shall support the integrity and authentication of the source and destination and data.

Also the DCU shall have fast recovery from abnormal situations and physical security to protect DCU from any unexpected actions from outside.

Create access logs, both for local or remote access through communication channels.

4.3.5.1.6. Internal Real Time Clock

The DCU shall have internal Real Time Clock with battery backup for accurate time sampling and may be automatically synchronized with HES ~~an external Time Server~~.

~~Also DCU shall monitor and if necessary to correct the time values of meter if the time value of meter is wrong.~~

All meter readings and events shall be recorded with time stamp value. ~~The DCU shall be capable to automatically correct internal time from the HES. Also it shall automatically correct the time parameters of connected meters if meter's real time clock value lost synchronization.~~

~~(ĐỐI VỚI CÔNG TƠ CÓ RCT THÌ LẤY TIME STAMP TỪ CÔNG TƠ. ĐỐI VỚI CÔNG TƠ KHÔNG CÓ RCT THÌ LẤY TIME STAMP TỪ DCU)~~

4.3.5.1.7. Internal Battery for operation at power outage

The DCU shall have internal rechargeable battery enough for internal operation and data communication to HES, but not for supporting downlink communication to meters. DCU shall inform about any abnormal condition without dependences to main power supply. DCU shall continue to work and inform HES about main power outage.

¹ 128/256 AES - The Advanced Encryption Standard (AES) is a specification for the encryption of electronic data established by the U.S. National Institute of Standards and Technology (NIST) in 2001. Used three different key lengths: 128, 192 and 256 bits.

4.3.5.2. Operation

4.3.5.2.1. Stand-alone operation

The DCU shall support stand-alone operation and continue to work in case uplink to HES is fail. The communication between DCU and meters shall be independent from HES and process shall be able to operate in any status of HES or communication between DCU and HES. DCU shall be able to operate in stand-alone mode without waiting any commands from HES.

4.3.5.2.2. Auto-detection of new meters in the grid

The DCU shall be able automatically discover the meters or topology changes.

4.3.5.2.3. Automatic collection of meters data

The collection of a meter's data by the DCU is automated. Automatic data collection may be based on Scheduler, Events and Requests.

4.3.5.2.4. Automatic sending data to HES

The DCU forwards meter data to HES in an automated manner. Automatic data sending shall be based on Schedule, Events của DCU and Requests from HES.

4.3.5.2.5. Storing of meters data

The DCU shall be able to store meter reading data (aggregated by meter).

The meter reading data shall be stored in DCU after each meter reading sessions. It can be accepted if meter reading data stored on meter, modem... instead of DCU.

4.3.5.2.6. Support of on-demand requests

The DCU shall support on-demand requests initiated by the HES.

4.3.5.2.7. Activity history

The DCU shall store a log of activities (this includes registration, data transfers, alerts and faults) with time-stamp.

4.3.5.2.8. Internal data storage capability

Internal data storage of DCU shall be at least 1 months for at least 500 meters. The load profile shall be able to store with time intervals up to 30 minutes.

Bộ nhớ trong của DCU có khả năng lưu trữ dữ liệu 30 phút interval của tối đa 500 công tơ trong vòng 10 ngày.

4.3.5.3. Communications Functionalities

4.3.5.3.1. Communication with HES

DCU shall support the following standard protocols: TCP/IP, IPv4, IPv6, DHCP, HTTP (client and server), SNMP, NTP, VPN, IPsec, and SSL/TLS Internet.

4.3.5.3.2. Communication with meters

The DCU shall be able of bidirectional communication with meters.

DCU shall have possibility to communicate with meters via at least one of the following: PLC, RF mesh ~~or equivalent technologies~~. It shall be ready to access the meters via **at least one of the following protocols**: DLMS/COSEM, ANSI C12, **IEC 61107 (IEC 62056-21 VÀ IEC 62056-61)**, Modbus or proprietary protocols with its description.

In any case protocols shall be compatible with those in the meters connected below the DCU. Interoperability with other brands shall be ensured according to the conditions in the technical specifications. In particular, while unitizing PLC technology for communication with meters, the DCU shall support one of interoperable PLC protocols (Meters and More, PRIME, DLMS, G3, IEC 61334, IEEE P1901.2, ITU G.hnem, OPEN protocol, etc.) or proprietary PLC protocol of selected meter vendor.

In case of RF communication with meters, DCU shall work with licensed-free frequencies approved by the Authority of Radio Frequency Management (ARFM) to be allowed to operate in Vietnam **hoặc tần số đã được EVN đăng ký (utility-licence 408.925Mhz)**.

4.3.5.3.3. Gateway functionality

DCU shall be able to provide a direct transparent link (tunneling) to the end meters from HES.

4.3.5.3.4. Interoperability

Capabilities of DCU communicate with different types of meters.

The Supplier shall provide the external testing entity certificate (such as DNV KEMA, NEMA, EPRI, etc.) that proves that the data concentrators are interoperable to at least three different meter manufactures based on the required functionalities in the bidding document for PLC and/or RF Mesh technology. In case of same manufacture, the Supplier shall offer the meter samples of two different manufactures for purpose of interoperability testing.

4.3.5.3.5. Integration flexibility

The DCU shall be ready for integration into other solutions developed by 3rd party vendors.

4.3.6. Technical Requirements

4.3.6.1. Electrical

The main characteristics of the power supply unit are listed below:

- Input power: Concentrator will be powered from a single phase (phase-phase or phase-neutral):
 - AC input voltage:

■ Nominal Voltage (Vn)	220 V
■ Voltage variation	±5% Vn
■ Nominal Frequency	50 Hz ± 5%
■ Isolation Level	6 kV (1.2/50 μs) with galvanic isolation of AC and DC sources.
- Self-consumption: ≤10W (Concentrator without GPRS modem)

4.3.6.2. Operational Conditions

For outdoors installation protection degree of IP65 shall be necessary.

Below are listed the main characteristics of the Data Concentrator:

- Operating Temperature: -5 to +70°C
- Storage Temperature: -10 to +70°C
- Humidity Range: <=95% non-condensation.

4.3.6.3. Lifetime and Reliability

- Product Life: More than 10 years
- Failure rate: <=0.3% per year

4.3.6.4. Mechanical

External case shall meet requirements of operational conditions and consists from synthetic resin.

4.3.6.4.1.Dimensions

The data concentrator dimensions shall be specified by the Supplier.

4.3.6.4.2.Cabling and connections

Each terminal shall allow screwing wires in the range of 4 to 6 square mm.

The insulation level is: 6kV (1.2/50µs).

A clear identification of all the connections shall be made visible for installation and maintenance operations.

4.3.6.5. Technical Conditions for Communication and interfaces

The equipment shall fulfill the following provisions:

- The data concentrator shall allow local and remote parameterization of the connected meters and well as the data concentrator itself. Remote parameterization shall be provided from the HES system and local parameterization at the data concentration on side by using the Service Workstation and the local RS232/485 interfaces of the data concentrator.
- The concentrator shall support both Pull-type and Push-type communication modes. The user can determine the type of data that needs to be sent on either mode.
- Dynamic network topology: The data concentrator shall be capable to automatically discover the added meters as the result of the dynamic network topology changes.

4.3.6.6. Visual signalling

- The DCU shall support and/or handle a set of LEDs to indicate the status of the communications. These LEDs shall be visible from the DCU or through the DCU cover.

4.4. Replacement Cost

The Supplier shall specific all replacement cost of the data concentrator units (including modems and repeaters (if any)) in case of damaged after completing warranty period.

5. HEAD END SYSTEM (HES)

5.1. Objective

The main goal of this specification is to present the requirements to be accomplished by the software (1 or more) responsible for the Data Acquisition and administration of the communication network, as well as the additional services necessary for its deployment and technical support.

5.2. Description

It is a software management platform that allows the operators to perform remote measurement operations, upload of files, analyze, process and exchange data with the Metering Data Management System to reduce commercial losses. The HES shall be a shelf, ready and fully operational product (1 or more), not including any development service, exception made for the integration with other Information Systems of the Utility, for the adaptations to the their IT environments or for the new features later required by the Utility.

5.3. Specification of the HES Environment

5.3.1. Technical Characteristics

- All the hardware environment of the central subsystem shall be compatible with the current platform of the Utility;
- The system shall operate using preferable an Oracle database or Microsoft SQL. The Supplier shall furnish all the Manuals for the operation, administration and maintenance of all the applications involved in the solution during their initial supply and at every new update of the systems that will imply in modification thereof. It shall be included in this documentation at least the following technical documents in the system: Installation and Implementation Manual, User manual, Reference Manual, the Software Design and a DER - Diagram of Entities and Relationships;
- The complete system documentation shall be delivered in English and Vietnamese.

5.3.2. Architecture and System Requirements

- The system shall have at least the following layers bounded by independent programs: application and database server with its corresponding redundancy.
- The GUI shall be integrated in such a manner that the same data entry can be used in all operations of the system, in order to avoid duplication of work;
- The messages and screens of the system shall be exhibited in the national language of the country; during the phase of acceptance test they may be exhibited in English, but the final delivery shall be in the national language of the country;
- The HES shall have the resources of auditing trail and recording of transactions that were made: who made, when and where they were made;
- Capacity of increase of the hardware components as required for the improvement of performance (horizontal scalability);
- Ability to migrate to a hardware platform for better performance (vertical scalability);

- Scalability of the components considering the following aspects:
 - Processing Capacity;
 - Data storage;
 - Increase in the number of simultaneous clients without loss of performance;
- It shall allow "hot standby" for:
 - Application and Database server
- The system interfaces shall be Windows friendly;
- It shall have capacity for remote operation, through access from a local network or through the Internet in safe environments, enabling configurations, programming and control of the applications.

5.3.3. Scope of the Supply

- The HES shall be supplied complete with all the required hardware, applications, databases and other items necessary for its perfect operation;
- The Supplier will be solely responsible for the execution of all the installation services and supply of all the equipment needed to make operable the HES specified in this document.
- The Supplier shall include in its proposal all the applications and licenses to implement the HES, with all the characteristics and features defined in this specification. The licenses shall be for the perpetual use of the Employer;
- The HES shall be scalable and will allow the use of multiple instances provided they be integrated into a single database.
 - The Supplier shall indicate the additional costs for the utility to be incurred in the system expansion (hardware, software licenses, etc.)
- With the implementation of the HES, the Employer has to be able to remotely collect data from the meters for:
 - Billing
 - Fraud detection
 - Establish new tariff structures
 - Improve the service quality index
 - Reduce operational costs of commercial procedures
 - Control and management of customers loads
 - Resources in the field (transformers, cables, among others)
 - Improve network expansion planning.
- The Supplier shall include the supplies and activities necessary and mandatory for HES to be fully operational, including:
 - Supply of the system application software and of the hardware;
 - Configuration of the database;

- Implementation of the system including the installation of hardware, software and commissioning;
 - Implementation of the System Acceptance Test;
 - Provision of instruction manuals for the System, for Production and for Technical Support;
 - Initial training of the Employer's specialists, who will be responsible for the production activities, technical support and users of the features and tools of the HES.
- The Supplier shall provide a Maintenance and Support Agreement. It will include the following activities:
 - Implementation of the patches and corrections provided by the manufacturers of the software that compose the environment the HES;
 - Installation of new versions and releases, including their analysis, their suitability for the use in the processes adopted by the Employer, their installation and follow up of the support activities, object of the contracts of maintenance of the mentioned software;
 - Troubleshooting of hardware, software, network, and other operating systems for servers and workstations that may be related with the HES;
 - Help Desk support for the HES and any other components made available to the users, which includes: Support, preparation of scripts, description and systematic record of the problems, their immediate solution or deferral of these problems to teams in charge of work, installation and configuration of the associated software, creation and maintenance of users and evaluation of the processes.

5.4. Head-end System (HES)

Data collection and memorizing function collects data automatically in an efficient and reliable manner from the meter and memorizes (archive) them in a corresponding database or performs instant reading of the meter upon user request.

5.4.1. General Features of the HES

The system shall support the following data collection and functionality:

- **Daily consumption**
- **Consumption (daily, 30 minute or less)**
- 30 minute or less of data: Operation parameters (U, I, PF, F), meter registers, events log.
- Outage Counts;
- **Demand metering;**
- **Remote demand resets;**
- On-request reads;

- Shall permit the customer data entry and update;
- Entry, update and monitoring of data on installation and replacement of meters;
- Real time clock synchronization;
- Set up and change of approved mean power limit;
- **Change of voltage thresholds related to electricity quality;**
- Setup, change, review and synchronization of reading programmers/sequence;
- Setup, change, review and synchronization of programmers/sequence execution priorities;
- Setup, change, review and automatic update of communication route;
- Setup and management of grouping of meter reading;
- Any programmable or not programmable command can be sent individually or to any group of any level; Shall automatically provide the available data from each consumer unit starting from its selection;
- Shall allow the exportation of all meter data from the system to ASCII, TXT, XML, CSV or Excel files;
- Shall allow the allocation of consumer units for analysis groups and relocate them, when necessary;
- Shall generate summaries of the events with information about power, current and voltage, alarms, etc.;
- Shall have features that will allow performing the activities related to the management of the measurement and actions related to the protection of the revenue;
- Shall generate graphical reports and statistics related to active energy, reactive energy, demands and quality parameters;
- Shall generate statistics of periodic events (frequency and duration) per measurement points, per occurrences;
- The system shall generate histories of all the parameters per measuring point;
- The System shall have functionalities that will allow the setting for a scheduled electric energy meter readings, in addition to allow on-demand access, at any time, to these same points of measurement;
- The System shall have functionalities to define priority on system Commands;
- The communication with the meter shall be done using the serial number of the same and the customers ID or customers account number;
- For any command sent the system shall have a feature for tracking their situation, such as: command sent, command received by the meter, command performed, etc.
- The HES system shall be able to monitor read meter data during data processing. Must report the status of the reading process, percentage of advance, etc.;
- Shall permit to define a Calendar with holidays;
- Shall permit to define and schedule automatically reading according to the reading route;

- Must show the Consumption charts (Hourly, daily, weekly, monthly) of active energy of the measurement point, with at least the following features and characteristics:
 - The period, under the initial conditions of implementation, shall automatically present the available reading period;
 - Line type chart or bar type chart, with different colors for each type of quantities;

5.4.2. Specific Features of the HES Used For Indirect Meters

5.4.2.1. Meter Administration, Visualization and Change management

Respect to the Meter administration it shall support the following functions in addition to those as indicated in Section 4.4.1:

HES có khả năng lập trình từ xa các tham số của công tơ có khả năng lập trình bao gồm nhưng không giới hạn những tham số sau:

- Meter parameters entry and update
- 30 minutes or less of interval data
- Tariff programmed change
- Change of display period value on meter display
- Change of sequence and selection of registers for display on meter display
- Change of electric power integration period
- Controllable output management
- Change of registers within profile framework.
- Change of profile periods
- Change of voltage thresholds related to electricity quality
- ~~Meter software change and Meter Firmware Update~~→.
- ~~Software shall be able to read any meters that provide a standard communication interface~~

It shall allow at least the visualization of the data of the parameters of each point, with, at least the following information:

- Meter's operating system version
- ~~Inductive PF (power factor) and capacitive PF,~~
- ~~Magnitudes of channels~~
- Battery status
- ~~Composition of the channels to calculate the PF~~
- The interval range of mass memory storage
- Integration interval,

It shall allow the visualization of the data from all available channels on the meter in daily,

weekly or monthly segmentation, for initial / final specified periods (day / month / year) in intervals of 1, 15, 30 (default) or 60 minutes, with exportation for, at least, the Excel format;

It shall allow the visualization of the data registers from channels, from every point, with at least the following information:

- Total active power at the direct
- Total active power at the reverse
- Total reactive power at the direct
- Total reactive power at the reverse
- Active power under tariff at the direct
- Active power under tariff at the reverse
- Peak power under time of use (TOU) at the direct
- Peak power under time of use (TOU) at the reverse
- Latching index
- Current (3 phases)
- Voltage (3 phases)
- Power factor
- Frequency
- Events log

According to the capacity of the meter, it shall be possible to extract archives from all meters channels.

It shall have a screen for visualization of, at least, the last ten energy failures in the measurement, with date and time of the start of the fault, date and time of the end of the fault and detailed duration in days, hours, minutes and seconds;

It shall allow at least the following changes:

- Date;
- Range of demand;
- Multiplication constants;
- Time segments;
- Condition of reserved time;
- Method of demand calculation;
- Automatic replacement of demand;
- Method of calculation of the quantity of energy corresponding to the reactive energy surplus;
- Visualization of the display codes;
- Condition of the serial output of the user;

- Presentation format of the display quantities;
- Micro-adjustment of the clock;
- Reading;

5.4.2.2. Generation of Reports / Charts

It shall allow the generation of graphs of the measuring point, with at least the following characteristics:

Zoom functionality (increasing and decreasing), making possible amplifications for detailing specific areas of the graph and subsequent return to the initial conditions sizing;

The system shall allow for at least the availability of the following graphs:

- Power factor graph: it shall have as a central reference on the horizontal axis the value of power factor equal to one or other adjusted value based on the available data. Values in the lower part of the chart shall correspond to inductive power factors and in the upper part to capacitive power factors.
- Graph of the load curve (daily, weekly, monthly) from the point of measurement and from the available channels, with at least the following features and characteristics:
- Option to view the data recorded in any of the channels (as available in the meters);
- The period, in the initial execution conditions, shall automatically offer the available reading period;
- Possibility of choice of the date and of the time of the start and of the end of the analysis;
- Line chart or bar chart types, with different colors for each type of quantity;
- Ability to export data;
- Recommended to include Phasor Analysis, angles and magnitudes

5.4.3. Specific Features of the HES Used For Direct Meters

The HES shall support in addition to those as indicated in [4.4.1](#):

- Demand Side – current limit.
- TOU

5.4.4. HES Administration Function

The HES shall support the following functionalities:

- Defining of roles and users/user groups
- Access control to System components
- Administration of reporting functions
- Execute a regular backup of all data at the desired time.
- Defining of user/user group rights

HES system shall provide such data access and target functionality that shall ensure that only authorized users could use the system, within the scope of their authorizations according to the security level. Records shall be kept about the users having system access, with specification of privileges for each user, as well as system access records (identification of successful and unsuccessful attempts).

When user privileges are changed, HES system shall register the security level change, time of the change and who executed the change.

HES system shall implement a security procedure on all access levels through the usage of users, groups of user, as well as their roles. Security procedure shall support the possibility of allocating users within specific or standard groups, whereby; roles are defined in the way enabling the application to individuals or groups of users.

5.4.5. HES Reporting Capabilities

5.4.5.1. Analysis of statuses and alarms

This type of reporting functions processes alarms and statuses of meters/concentrators, event logs, with the making of corresponding reports after finding corresponding alarms, statuses and events.

Result of such reports shall be the daily, i.e. periodical report on the state clearly showing all alarms, statuses and events and on which meters, representing the basis for further action on these meters.

5.4.5.2. Reports on electricity quality

This reporting function would execute analysis of voltage circumstances on meters themselves since there are corresponding records in the electricity quality log recording voltage drop/overvoltage below/above defined voltage thresholds and supply interruptions. In this way, the function would indicate poor voltage circumstances with one or a group of customers and it would represent the reason for the crews to go out into the field.

5.4.5.3. Communication reports

Successfulness statistics of communication between system elements represents a special whole within the reporting functions.

5.4.5.4. General

All reports shall be capable to be downloading to Excel, ASCII or TXT file.

Print/Print Preview option is mandatory with every report automatically generated in the form of PDF file.

5.5. User and Operator Interface

It is desirable that administrator and client GUI (Graphical User Interface) is realized on the latest computer platform not requiring special software installation.

5.6. Definition and Handling of Master Data

Definition of meters, communication paths and (extract of) meter variables to be acquired.

- The system shall support master data of meter and communication devices.
- The system shall store via which communication device the meter can be connected to the system.
- The system shall store which of the registers of the meter should be acquired.

5.7. Communication Capabilities

- ~~The HES can connect to the meter directly or indirectly via the concentrator. The HES shall support different communication paths and methods.~~
- HES shall have the possibility to administrative, CONFIG and group communication devices (DCU,...) in communication pools.
- ~~HES shall support concept of a backup communication path.~~
- ~~HES system shall support dynamic IP addresses for GPRS communication.~~
- The HES shall support the physical meter change.
- The HES shall have the possibility to group meter acquisition in meter lists.
- The HES shall support automatic generation of dynamic meter lists where acquisition was unsuccessful ("error lists"). Error lists shall be processed automatically.
- Time synchronization of meters and data concentrators with centralized precise clock upon TIME SERVER national standard. (thêm mô tả đồng bộ thời gian của MDMS).

⇒ ĐƯA LÊN PHẦN ĐẶC ĐIỂM CHUNG CỦA HES

5.8. Data Management

5.8.1. Data Grouping

Key information of HES systems is grouping of gathered meter data for the following purposes: billing, reporting and analysis.

5.8.2. Meter Data

- The HES system shall provide information about missing or not yet acquired meter data for a certain time period.
- The HES shall store the raw data and the report data of the meter registers. Raw data values are the data how they are stored in the meter register. Report data values are the

data after the pulse value-matching factor changed the raw data to consumption data (for example into KW/h).

5.9. Data and Information Exchange Functions with MDM System

This portion identifies elements that need to be transferred to and from MDM system. Data transfer request shall be executed consistently to and from MDM system, information subsystems within electric utility and other interested parties.

5.9.1. Data Entry into HES System

Data entered into HES system include:

- Information related to reading Cycle and routes
- Data on network resources on which End Point have been implemented

5.9.2. Data Submitted To MDM System

The type of information transferred between HES and MDM System:

- Data on metered consumption for households, at a daily level; data on consumption shall be transferred at the end of every day.
- Data on metered consumption for households, at an hourly level; data on consumption shall be transferred at the end of every day.
- Data on metered consumption for Industrial and Commercial Customers, at a daily level; data on consumption shall be transferred at the end of every day.
- Data on metered consumption for industrial customers; data on consumption shall be transferred either as 15 or 60-minute data at the end of the every day.
- Interval Data
- Operation parameters, immediately data such as all events and alarms of meters,...etc.
- Data on the network resource where the meter is connected

5.9.3. Data Exchange Methods

Have the ability to exchange data with systems being used or will be developed in the future. The interface can be directly (access to the database directly) or indirectly. The communication with other applications can be performed the following methods:

- Exchange by file formats: Excel, Text.
- Send and receive data in XML format.
- API function, web service comply with standard IEC61968. The HES shall have passed EPRI IEC 61968-9 interoperability tests.
- The system shall be able to exchange data without restriction.

5.9.4. Voltage Variations

The HES system shall show the endpoint registers voltage variations in accordance with the meter parameterization or HES configuration.

6. SECURITY

6.1. Encryption

- All data transfer from end to end shall be encrypted.
- Secure Sockets Layer (SSL) protocol shall be used for IP based connection. Secured sockets shall be used for Web services.

6.2. Authentication

- User management, Group users, roles of users and group users respectively.
- The System shall implement a security procedure on all access levels through the usage of users, groups of users, as well as their roles.
- User access by identifying the user with username and password every user of the application has access the application with a unique user name and a unique password integrated with EVNHCMC's Active Directory service. Without the valid combination of user name and password the access to the application shall be denied.
- Create multiple user access priority level software / function / module / different data areas.
- Records shall be kept about the users having system access, with specification of privileges for each user, as well as system access records (identification of successful and unsuccessful attempts).
- The user account is locked after a number of failed login attempts. The number of login attempts is set by the administrator as a system setup.
- When user privileges are changed, the system shall register the security level change, time of the change and who executed the change.
- Logging of all system events. All of the system events shall be stored in the system according to the time period required by the user (e.g. 7 days, 30 days, 365 days, etc.) to serve the track. This data can be removed manually or automatically by the HES administrator.
- Mobile administration software shall use certificates for authenticate field tools.

7. HARDWARE

7.1. Server General Requirements

The proposed system shall be designed for an open & scalable configuration, to ensure the inter-compatibility with other systems of the Utility, the future smooth expansion as well as the easy maintainability. The proposed hardware configuration shall be extended by adding either CPU / memory module / disks etc... in delivered units or additional units for capacity extension.

All hardware shall be manufactured, assembled, finished, and documented with workmanship of the highest production quality and shall conform to all applicable quality control standards. The hardware architecture shall be based on open system with a very high level of operational security and safety.

All computer equipment shall be current models from main worldwide computer manufacturers selected for efficient operation of a real-time system.

No proprietary hardware can be accepted for servers and workstations.

The Server shall include facilities for orderly shutdown and resumption of processor operation upon detection of power loss and subsequent resumption of power.

Redundancy of equipment supporting critical functions is mandatory.

The hardware shall be connected to an Ethernet LAN network. The system architecture shall ensure fast communication between servers and workstations.

Employer prefers the utilisation of commercially-available hardware (Commercial off-the-shelf; COTS) for as many of the system components as possible.

In the field performance test and prior to the end of warranty period, the Supplier shall have all hardware inspected and certified as acceptable for service under a maintenance contract by the local service offices representing the equipment manufacturers.

7.2. Form of Hardware

To the greatest extent possible, equipment shall be supplied as rack mounted or blade units, unless otherwise specified.

The supplied model of equipment shall has redundant power supplies.

The power supplies shall incorporate automatic voltage selection and hot swap capability. In case of failure of one of the redundant power supplies, the other one shall support the power needs for the whole equipment.

The server storage system shall have hot swap capability and support RAID 0, 1 or more.

The hardware shall have a minimum of two (2) 1 Gb speed network interface cards (NICs). The NICs shall be configured in a team or redundant fashion to support no single point of failure (NSPOF).

7.3. Servers

The Supplier shall provide the servers that capable of handling at least 100.000 metering points.

All the servers' components (CPU, RAM, Hard disks...) shall be dimensioned to answer the operational system performance required for data processing to ensure that the metering data point will be updated in period of 30 minutes for one time.

The data of the system will be updated online or the system shall support the multi-tenant architecture.

The servers shall be able to process the data in memory.

The Servers shall be implemented according to the full redundancy concept and shall be equipped with sufficient hard disk capacity and main memory to hold the complete database and to perform data analysis, verification, filter and calculation functions, etc... which are required for efficient application server sharing.

The servers shall run in active-active mechanism.

~~The servers shall meet the growth rate of ten percent (10%) of end-point yearly during next 5 years.~~

Servers shall be mounted in rack space, power and heat dissipation.

Servers running preferably under Windows™ or Unix based operating system, of a redundant set of servers shall be connected to both LANs in order to cope with the high availability requirements.

7.4. Other Peripheral Devices

The Supplier shall supply any other peripheral devices or equipment normally provided for operation, software support, and maintenance of the HES.

7.5. Power Supply System

The Employer shall provide power supply system that includes uninterruptible power supply system (UPS) and standby diesel generator system.

The Supplier shall provide the power cable for the loads.

7.6. Local and Wide Area Networks

7.6.1. LAN Network

The Employer is responsible for the supply of the LAN network. The LAN network be based on Gigabit Ethernet.

7.6.2. Employer' Corporate WAN

The HES shall interface to the Employer' Corporate WAN.

The Employer is responsible for the supply of the Corporate WAN.

The Supplier shall be responsible for the connections from the HES to the Employer' Corporate WAN.

9. TESTING

9.1. Test Responsibilities

Both Employer and the Supplier shall designate, in writing and prior to the start of the test, a test coordinator. The test coordinators shall:

- Ensure that the tests are conducted in accordance with the requirements of this Contract.
- Have the authority to make binding commitments for their employer such as approvals of test results and scheduling for variance corrections or, as a minimum, to cause such commitments to be expeditiously made.

Supplier shall be responsible for all site tests with the exception of the Availability Test. This responsibility shall include the conduct of the tests and all record keeping and document production.

The Employer shall support the site testing by supplying staff to monitor the tests. Employer expects that at least two Supplier staff will be on-site during these tests.

9.2. Test Documents

Test plans, procedures, and records shall be provided by the Supplier for all tests to ensure that each test is comprehensive and verifies the proper performance of HES elements under test.

The test plans and test procedures shall emphasise the testing of each functional requirement, checking error conditions, and documenting the simulation techniques used.

The test plans and test procedures shall be modular to allow individual test segments to be repeated as necessary.

All test plans and test procedures (standard, modified standard, and custom functions) shall be submitted to Employer for approval and shall be subject to the approval process.

9.3. Variance Recording and Resolution

The Supplier shall establish a process to record and track variances.

Variances shall be used to record system deficiencies, including but not limited to:

- Documentation deficiencies.
- Functional deficiencies.
- Performance deficiencies.
- Procedural deficiencies.
- Test deficiencies (as when the system cannot satisfactorily complete a test procedure due to a problem with the test).
- Security deficiencies

The variance process shall produce reports of all variance information and shall produce reports of subsets of the variances based on searches of the variance parameters singly and in combination.

The variance recording and tracking system shall allow the on-demand production of reports of all variance information. Variance recording and reporting shall be available to the Employer at all times via the Internet subject to secure access.

The Supplier shall periodically distribute a variance summary that lists for each variance the report number, a brief overview of the variance, its category, and its priority.

9.4. Test Schedule

The Supplier shall provide a detailed system test schedule that is consistent with project phasing.

- The test schedule shall cover all aspects and components of the HES, including backup modes of operation, full integrated operation and engineering.
- The detailed test schedule shall be subject to Employer approval.

All equipment documentation shall be completed, reviewed and approved by the Employer before any testing.

The test schedule shall allow sufficient time for verification or additional unstructured testing by the Employer. The Employer shall be able to schedule unstructured testing at any time, including during structured tests.

9.5. SITE ACCEPTANCE TEST

Site Acceptance Test (SAT) will be conducted after the system has been installed after successful start-up of the system. The system will be subjected to a subset of the functional performance tests. The SAT will also include any type of testing that could not be performed in the factory. Unstructured tests will be employed by Employer, as necessary, to verify overall system operation under field conditions. Any defects or design errors discovered during the SAT shall be corrected by the Supplier.

After the system loaded (in-service) test procedures and plans to be conveyed to the Employer.

9.5.1. General Site Acceptance Test

The Site Acceptance Test (SAT) will be conducted once the Supplier had installed the 10% of the total meters requested for **direct meters and indirect meters**.

- **On request read and Validation of actual meter reading values**

Pass Criteria: On request reads will be performed for up to 100 meters and valid meter data will be returned for all meters for which data is received. Validation will be conducted by manually reading the meter value and compared with the on request read. A minimum of 95% of the tested meters shall return valid data with the first attempt. In the event that 95% successful reads are not obtained, two more retry will be allowed for each unsuccessfully meter read. The final value for acceptance test is 100%.

- **Scheduler Total consumption reads**

Pass Criteria: An AMR schedule will be created for all meters and upon the successful completion of the AMR read operation, a valid read values of the associated meter data will

be returned and entered into the database table for all meters for which data is received. A minimum of 99% of the tested meters shall return valid data with no more than two automatic retries.

- **Hourly read**

Pass Criteria: An AMR Hourly read schedule will be created for all meters and upon successful completion of the AMR operation, valid hourly values and associated meter data will be returned and entered into the database table for all meters for which data is received. A minimum of 95% of the tested meters shall return data. The test will gather a consecutive 48 hours worth of hourly data to verify data is not duplicated beyond the 24-hour period.

- **Communication Failure Test**

Pass Criteria: An AMR hourly read schedule will be created for all meters. Break the communication link from HES during the read process to simulate a failure in the communication link, by shortly disconnecting the communication line. Reconnect and allow the process to continue. Valid, non-corrupt data readings and associated meter data shall be returned for all meters for which data is received. The purpose is to verify the ability of the software and remote equipment to have the communication interrupted and then resume the transmission of valid accurate data when the communication is restored.

- **Alarms Test**

Pass Criteria: For at least 10 meters verified the interruption alarms system provides.

9.5.2. Specific Site Acceptance Test for Indirect Meters

- **Load Profile**

Pass Criteria: For 10 different connection meters have the meter disconnect one phase of power from the meter. Execute on demand read and review that the meter registered this event. Repeat the test doing power off to two phases.

- **Missing Phase**

Pass Criteria: For one polyphase meter disconnect one phase of power from the meter. Execute on demand read and review that the meter registered this event. Repeat the test doing power off to two phases.

9.5.3. Specific Site Acceptance Test for Direct Meters

- **Energization / De-energization Test**

Pass Criteria: For at least 10 meters verify that the energization and de-energization of the meter is detected and reported.

9.6. Availability Test

A 1440-hour (sixty days) availability test shall be conducted for the complete system after the completion of the SAT. The test shall be performed under actual operating conditions. The Contractor shall have his qualified representatives available at all times during the test, the

purpose of which is to verify the reliability of the system hardware and software. The Supplier shall bear the responsibility for all corrective maintenance on the system; the Employer, however, may correct problems under the supervision of the Supplier. The Employer will be responsible for the system restart, notification to the Supplier of service requirements, and preventive maintenance.

9.6.1. Test criteria of the availability test

The system shall meet an availability of at least 99.99%. This availability shall be calculated pro-rata for the actual duration of the test.

System availability shall be computed using the following formula:

$$\text{System_Availability} = \frac{\text{Test_time} - \text{Down_time}}{\text{Test_time}} * 100\%$$

No more than a total of two automatic or manual failovers or restarts of the central processors shall be permitted during the test in order to recover from problems with the system operation. The test shall be considered to have failed if this number is exceeded.

9.6.2. Test completion requirements

If the guaranteed availability cannot be demonstrated at the end of 1440 hours, the Supplier may continue the test by moving the starting time of the test forward and continuing the test until the 1440 consecutive hours have been accumulated. If this exceeds 3 starting times or this period exceeds 180 days, the system shall be deemed to have failed the test.

If the system fails the test, the Supplier shall make all needed hardware and software corrections, and the test shall be rerun and repeated until successful. The Supplier shall bear all correction and test rerun costs. The taking over certificate shall not be granted until this test is satisfactorily completed.

On successful completion of the Availability Tests, the Employer will take over the system and the warranty period shall begin.

10. DOCUMENTATION

Documentation shall be provided for all equipment and functions provided by the Supplier as part of this procurement.

All documentation shall be in English and shall be subject to review and approval by the Employer to guarantee an acceptable level of written English is delivered.

The documentation shall describe meters, communication and HES, including all of its hardware, software, and interfaces and shall cover functionality, testing, configuration, installation, system start-up, operations, and maintenance and all other deliverables. All equipment within the scope of supply shall include documentation.

Documentation shall be available in the System and this is described elsewhere. All documentation shall have an electronic copy and shall be suitable for integration in a web portal. All documentation shall be structured and have a common root with indexes per subject. This shall include original equipment manufacturer (OEM) documents as well. System shall include documentation control tools including search, version management and update control.

The intent of the documentation and the ensuing review and approval process is to ensure that it is of a standard and coverage so that when coupled with the delivered Training will ensure that the Employer will be self-sufficient in maintenance of the System. Where it is deemed by the Employer that the documentation fails to fulfil this intent, the Supplier shall make good and shall deliver additional documentation as directed by the Employer.

12. TRAINING

The Supplier shall prepare and deliver a comprehensive training program on the operation HES and maintenance of HES, communication equipment and any other equipment supplied in this Contract..

Database, user interface and report maintenance training shall teach Employer personnel the skills needed for initial database and display construction and verification and operational system maintenance and expansion.

Software training shall equip Employer personnel with the skills required for HES and communication equipment maintenance and expansion and for the preparation and integration of new functions.

Hardware training shall qualify Employer personnel to perform maintenance and perform diagnostic tests on the processors and their peripheral equipment, LANs, and User Interface, security and communications equipment.

Operator training shall enable Employer Operators to develop the skills required for performing their duties in the new system environment and shall include comprehensive training on the features of the HES and communication User Interface.

Security training shall enable Employer personnel to adequately perform the operations required to configure, maintain and operate the security equipment and software.

System administration training shall enable Employer personnel to adequately administrate HES software configuration environment including system optimisation, parameter tuning, definition and control of user profiles, implementation and testing of new software versions, and system configuration management including the interpretation of configuration failure alarms and diagnostic of abnormal situations, the ability to perform the reconfiguration actions when failures occur and for systems expansions, etc.

Capacity building training shall be provided that enables Employer personnel to appropriately apply the available toolset within the HES for the management of the system. The courses shall be structured to develop a clear understanding of “why” and when an application is used as opposed to the “how” it is used.

General User and Operator training shall be provided to prepare the Employers staff for full scale operation of the HES.

12.1. Scope of Training

The supplier shall provide On-the-job Training (OJT) services to the Employer. The training will be conducted in the Employer’s country (in Vietnam).

The training curriculum shall comprehensively train Employer staff on all hardware and software to be provided under the Price Schedule.

12.1.1. Self-Study Courses

The Supplier shall provide classroom style courses for all training.

Self-study training using books, computer-aided instruction (CAI) or computer-based training (CBT) may be used as supplementary training. A copy of any video, CAI program, or CBT program used in training shall be provided to Employer as part of the training documents.

12.1.2. Recording of Courses

Employer shall be permitted to make video and audio recordings of all training classes.

Employer shall be entitled to use these recordings solely for internal instruction purposes and will not release the recordings to third parties.

12.2. Training Documents

The Supplier shall prepare a training plan in consultation with Employer.

The Supplier shall also be responsible for the preparation and production of all course material.

Training documents shall be subject to the review and approval by the Employer.

12.2.1. Training Plan

The training plan shall support the system implementation schedule.

The Supplier shall define the training plan in a logical sequence of courses so that training on base system elements (such as the meters, hardware platform, network platform, operating system, languages, database, and displays) is given before the training for specific HES elements (such as applications).

The training program shall take into account the knowledge required by members of Employer project team in order to participate in the project.

The training plan shall list each course to be taken, the dates for the course, and the expected number of students to attend.

Training shall be scheduled to minimise the loss of knowledge through lack of use. Training shall be scheduled so that there will not be long periods of time between training and the use of the training.

The training plan shall not assume that all courses may be delivered consecutively and shall allow for a reasonable break between courses to allow Employer staff to maintain existing duties. The schedule for the training plan shall allow for multiple trips by the Supplier's training staff to complete the full set of training courses.

12.2.2. Course Descriptions

Course descriptions shall be included with the training plan that shall provide the following information for each course included in the training plan:

- The course name (and number if applicable).
- A brief description of the course.
- A description of the intended audience, goals and objectives for the course.
- A description of the relation of the course to others in the training plan
- The duration of the course.
- A breakdown of the course schedule, identifying classroom, laboratory, and hands-on periods.

- A list of the training materials to be supplied.
- A list of reference material to be used in the course.
- A list of any prerequisite training or experience expected of the students.

At Employer request, the Supplier shall provide a description of all courses offered by the Supplier and its Subcontractors. Employer shall be permitted to request additional courses based on this list and accounted for with the balance of available mandays in the total Training Budget.

12.2.3. Course Material

The Supplier shall provide all necessary training materials, including course manuals and reference materials. These materials shall be provided in electronic format integrated to the documentation portal of all equipment supplied, and also printed copies as below.

Each trainee shall receive individual copies of the training materials and one additional set shall be provided for Employer archives. Each trainee shall have available individual computer facilities for visualisation and data input.

Class materials, including documents sent before the training classes and class handouts, shall become the property of Employer.

- As such, Supplier shall permit unrestricted reproduction of the material by Employer (for internal use).

All course material shall be transmitted to the students at least two weeks prior to the course.

The courses, material and presentation shall preferably be in Vietnamese, but English may alternatively be accepted.

12.3. Instructor Qualifications

Course instructors shall have demonstrated technical competence in the subject and previous instructing experience in that course. Employer prefers instructors who specialise in course presentation, as opposed to hardware or software developers who only occasionally present courses.

The Supplier may use the developer as the instructor for HES, network elements produced specifically for this Contract. The developer shall use appropriate training staff as resources when developing the training course and materials.

Where practical, subcontractors shall deliver training on their products directly. However, the Supplier shall remain responsible for selecting these courses, coordinating their delivery, and ensuring that all training objectives are met.

12.4. Location and Number of Students

The number of the students that shall attend each training course and the desired location for the course are listed in Table 9-1: Course Attendants and Location.

Table 91: Course Attendants and Location

Training Course	Number of Student	Duration Days	Man Days	Location
				Employer site (Vietnam)

12.5. Training Budget

Supplier shall be responsible for all expenses for training as classrooms, learning materials,... etc for the students while attending courses and on-the-job training.

Employer expects the courses to be taken and the number of students attending each course will change over the course of this Contract. Therefore, the total number of training mandays, based on the total number of training days identified in Table 9.1 and noted in the associated Price Schedule for all training included in this Contract shall be considered as an allocation. The Employer, in consultation with the Supplier, will revise the training curriculum, the number of attendees at each course, the number of days of training for the affected course, and the resulting number of training mandays.

At the completion of the Training Program, the training manday budget allocation will be reconciled with the actual number of training mandays as per the Terms of Payment in the Special Conditions of Contract.

The Supplier shall update the training budget each month with the actual costs of the courses taken by Employer throughout the duration of the project via the periodic progress reports.

The Supplier shall use the contractual per student manday cost to attend training as well as the per course cost to perform the training at Employer site in the determination of the training manday costs of the training. The Proposal shall specify all per student and per course costs.

12.6. No Additional Charges

Payment for any training in excess of the allocation will be reconciled as per the Terms of Payment in the Special Conditions of Contract based on the per student manday cost to attend the training courses.

The Supplier shall be responsible for the cost of additional courses and the travel and living expenses of students attending the courses where the need for such training is attributed to any of the following conditions:

- Significant delays in the project schedule caused by the Supplier.
- Inadequate or poor quality training that fails to meet Employer requirements for quality, content, or timeliness.
- Changes to any hardware or software deemed necessary during the project to meet the requirements of this Contract.
- Any change in the scope of this Contract, unless the cost of the additional training is included in the cost of the change.

13. PROJECT IMPLEMENTATION

This section specifies project implementation requirements, including Employer and the Supplier responsibilities, project management procedures, project documents, project security initiatives, the activities leading up to shipment of the all equipment comprising the installation, commissioning, and site test activities. The Supplier shall develop a logistical plan to perform a smooth data exchange from the HES to MDM system. The detailed plan shall be developed during the design phase of the project by the Supplier in consultation with the Employer. The plan shall be subject to approval of the Employer.

13.1. Implementation Responsibilities

The general implementation responsibilities of Employer and the Supplier are presented below.

Other sections in the Specification may also present implementation responsibilities.

If the requirements of any other sections conflict with the implementation responsibilities of this section, the responsibilities of the other sections shall take precedence over this section.

13.1.1. Supplier Responsibilities

The Supplier's specific responsibilities shall include:

- Providing all specified equipment and related support materials, including all interconnecting cables and wiring between all Supplier-provided equipment and between HES and the Employer communications links. The Supplier shall also be responsible for providing all materials and equipment necessary for data interchange between the current systems and the HES.
- Defining the stock of spare parts needed to maintain system availability until the completion of Warranty.
- Providing all engineering, software design, development, and integration services necessary for HES implementation with minimum interruption of monitoring and control of Employer application utilities.
- Providing and integrating all application software included in the scope of supply. This responsibility extends to all software developed by Subcontractors to the Supplier.
- The Supplier shall be fully responsible for the preparation, verification and integration of the database into the HES. In addition, the Supplier shall identify and enter any additional data elements required in the Supplier's database and shall in consultation with the Employer determine the correct values of those data elements.
- In consultation with the Employer the Supplier shall define operator roles, establish logins, security requirements and shall design the areas of jurisdiction that align with the Employer operating vision.
- Defining, documenting, and coordinating a software and database management methodology that shall ensure synchronization of HES databases and applications software, between the Supplier's factory and Employer site, until final shipment of all HES components.

- Managing, coordinating, and scheduling the activities of all Subcontractors employed by the Supplier for this project. This shall include the resolution of all problems that may arise in connection with the hardware, software, and services supplied by the Subcontractors.
- Implementing meters, communication network and HES according to the quality standards acceptable to Employer.
- Training Employer staff so that they will be self-sufficient and able to operate, maintain, and upgrade the complete meters, communication network and HES. This includes formal tutorial training and on-the-job training – OJT to Employer personnel, according to the Training section in this Specification, and providing the necessary means and services for Employer personnel when performing OJT at the Supplier’s facilities.
- The Supplier will provide the necessary means and services for Employer staff during the on-the-job training.
- Supplying meters, communication network and HES documentation according to the Documentation section of the Specification, such as instruction manuals, maintenance manuals, drawings, software design and user documentation, and other appropriate material including on-line documentation integrated in the documentation portal, that together fully defines the supplied system and allows Employer to operate, maintain, backup, restore, and upgrade HES hardware and software.
- Supplying final (“as built”) documentation that is accurate and complete.
- Providing adequate facilities and resources for performing the tests in accordance with the Testing section within these specifications.
- Providing an environment that allows reproducible execution of all HES functional performance tests conducted during site testing.
- Transportation and delivery of all Supplier-provided equipment and materials to Employer sites.
- The Employer will support providing the power supply system. The Supplier shall provide input power to equipment enclosures from the power supply system.
- Developing the installation plan that recognizes the criticality of continued monitoring and control of network assets. The Supplier shall perform the installation of meters, communication network and HES at all Employer site.
- Performing, with Employer oversight, system start-up after satisfactory system installation, including powering up the system, loading correct versions of all software and databases, activating data links, verifying correct operation of the system including checking the database and displays are correctly showing data and turning over to Employer an operational system ready for site testing.
- Performing, with Employer oversight, after delivery and start-up of the system, but prior to any site testing, setting up all functions for proper operation (system and function “tuning”).
- Participating in testing at Employer site, including correcting all reported variances.
- Ensuring and periodically demonstrating that the work is progressing according to the approved schedule.

- Providing office space and services for Employer staff and personnel participating in the OJT at the Employer's site
- Maintaining meters, communication network and HES up to the start of the warranty.
- Provide all necessary tools including database synchronization, database replication, etc. to ensure the overall HES database consistency.
- Develop in consultation with Employer a recommended plan to perform a smooth data exchange between the HES and MDM system with the minimum disruption of the operations. This plan shall consider the recommended parallel operation. The Supplier shall be responsible for the migration from the HES to Employer's MDM system in a way that the service interruptions will be minimal.
- Specifying the policy and the necessary capacity for backup & archiving / restore of data and image of HES, in advance, in order to allow Employer to prepare accordingly the Corporate Backup/restore facilities.
- Assure that the third-party software is covered by the support of the original manufacturer at acceptance.
- Supplying and installing the associated wiring to all supplied equipment, including connection to input power at the customers site and the Employers delivery points within the buildings, installation and necessary installation documentation in advance of and in accordance with the anticipated start-up of the meters, communication network and HES.

13.1.2. Employer Responsibilities

Employer will be responsible for the following:

- Providing communications links to connect to the System LAN but not the cabling or any intelligent switching or routing.
- Reviewing and approving project deliverables such as, but not limited to, detailed implementation schedule, software and hardware functional design documents, user manuals, custom display and report formats, drawings, progress reports, training program, quality assurance plan, test plans and procedures, test results, support services (including maintenance and Evergreen updates), and as-built system documents.
- Providing locations for installing the meters, communication network and HES.
- Providing documentation, interface details, engineering drawings, and schematic diagrams of Employer-furnished equipment to be directly interfaced with MDM system.
- Coordinating and supervising the Supplier's work to be performed at Employer facilities.
- Supervise the installation services performed by the Supplier.
- Participating in site acceptance tests, availability test and approving test results.
- Preparing variance reports, resolving variance issues, and approving corrected variances.

- Monitoring and verifying that the Supplier's work is progressing in accordance with the approved schedule.
- Verifying that all Supplier materials, installation practices, and workmanship conform to requirements.
- Providing authorizations and security means for suitable communications facilities, through a connection to the Internet by Employer Corporate Network.
- Providing facilities as required for on-site training.

13.1.3. Consultants

Employer expects to retain the services of a consultant for assistance with the project.

Consultants shall be considered as part of Employer' staff and shall be given access to all project documentation and information and shall be permitted to participate in project meetings, testing and all other project activities.

13.2. Project Organisation

The primary points of contact between Employer and the Supplier shall be their respective project managers.

13.2.1. Employer Project Manager

Employer project manager shall be responsible for representing Employer' interests throughout the project.

Employer project manager may, from time to time, authorise other staff to act in this regard for specific tasks.

The project manager may also change such assignments from time to time. Supplier shall be formally notified of such actions by Employer in writing.

All correspondence with Employer shall be addressed to Employer project manager.

13.2.2. The Supplier's Project Manager and Project Personnel

The Supplier shall designate a project manager who shall be responsible for the co-ordination of all project work and for the communications between the Supplier and Employer.

The Supplier's project manager shall not be removed or replaced without the approval of Employer except for conditions outside the control of the Supplier.

The Supplier shall restrict access to software and source code crafted specifically for Employer, Employer network, device configuration data (e.g., for the servers, workstations, switches, routers, firewalls, etc.).

- The list of those with access shall be provided to and approved by Employer. Such personnel shall be subject to appropriate background checks and other requirements stated in the Contract.

The project shall be staffed with a core project team. Additional personnel shall be assigned to work under the direction of the core team as required to effectively implement meters, communication network and HES.

Core project team members shall have previous experience in a similar position on at least one other project that is similar in size and scope to this project.

The Supplier shall inform Employer of any pending or possible changes in the use or status of all Supplier project personnel. Any changes to Supplier staff, including work assignments and participation level, shall be announced as soon as practical and shall be subject to Employer approval.

Employer shall have the right to have any Supplier staff removed from the project for cause and without justification.

13.3. Project Management Documents

Project management documents shall specifically include the following and shall be delivered to Employer by the dates indicated in the referenced section (where the content of the document is also further defined):

Table 101: Project Documents

Document	Reference Section
Documentation Plan	Section 10.3.2
Project Progress Report	Section 10.3.3
Project meetings, Agendas and Minutes	Per Section 10.3.4
Project Correspondence	Section 10.3.5
Detailed Implementation Schedule	Section 10.3.6

13.3.1. Project Plan

Supplier shall provide a preliminary project plan as a component of the Kick-off meeting and maintain a comprehensive project plan with periodic updates included with the project progress reports. At a minimum, the plan shall include the following:

- Methodology and Standards.
- Project Approach.
- Project Reviews.
- Staffing plan (including resources, by role, required for both Employer and the Supplier).
- General description of project deliverables (references to the approved Hardware and Software list of deliverables).
- References to other updated and approved project documents including the Documentation Plan and Project Schedule (reference to the approved project schedule).
- Project assumptions and potential risks.
- Support plans, i.e.:

13.3.2. Documentation Plan

A documentation plan shall be submitted to Employer twenty (20) working days after contract award.

The documentation plan shall describe, in detail, the Supplier's plan for the submittal of all subsequent documentation.

It is expected that certain major documents, such as the detailed hardware and software design documentation, will consist of a series of submittals made over a period of time. The documentation plan shall address this by including a detailed list of all individual documentation submittals for the project.

- This list shall include, but shall not be limited to, the following information for each document:

Document name.

Document number based on Employer standard document numbering scheme.

Document type (such as, functional design, detailed design, listing, or user guide).

Estimated and actual date of submittal.

Document status (such as, submitted for review, submitted for approval, returned for correction, or approved.).

The plan shall serve as a checklist throughout the project and shall be revised and resubmitted by the Supplier as necessary.

Documents shall be submitted in a sequence that allows Employer to have all the necessary information for reviewing or approving a particular document at the time of its submittal.

Documentation shall be submitted in a manner that allows for a reasonably paced review effort.

The documentation plan shall be subject to Employer approval.

13.3.3. Project Progress Reports

A project progress report shall be prepared by the Supplier and sent to Employer each month through the start of the warranty period. After the start of the availability testing, a management report shall inform about all incidents, defects, problems and maintenance events, use of spare parts and stock verifications, and about the updates performed in the system. This report shall be prepared and submitted every month.

The progress report shall be submitted to Employer project manager no later than the 10th calendar day of each month.

The progress report shall cover the project from the start of the contract through the last working day of the month.

The progress report shall include a general assessment of the progress on the project.

- This assessment shall include a report on status of the project progress milestones that shall reference the latest implementation schedule, which shall be included in the report.
- The schedule shall show the baseline and the current schedule, progress on individual tasks, and the forecasted completion dates for upcoming tasks and the entire project.
- Updated training and documentation plans shall be included.

The report shall include schedule variance information with:

- An explanation of existing and forecast schedule variances.
- The cause or source of the variance.
- The alternatives considered.
- Solutions adopted or recommended.
- The outcome achieved or anticipated.

The report shall note the needed delivery date of Employer-furnished information and/or equipment.

The Supplier shall be responsible for any schedule delays due to insufficient notification to Employer of the need for Employer-furnished information or equipment.

The report shall identify unresolved contract and technical issues. This shall include:

- A description of the item.
- The current due date.
- The consequences of any delay in resolution.
- Any recommendations pertinent to the decision process.

The report shall also include the following items:

- A list of action items, including the following information:

The action item number.

The date the item was opened.

References to the originating transmittal and any reference documents.

Action item status (open, closed, pending).

Resolution due date.

The responsible organisation or person.

A description of the action required.

The date of action completion (when each item is closed).

References to transmittals or other documents recording the resolution.

- Correspondence logs, one for transmittals to Employer from the Supplier and one for transmittals to the Supplier from Employer.

Each log shall have the following information for each transmittal:

The transmittal number.

The date of transmission (not the date written).

The date received.

The subject of the transmittal.

Identification of any action items addressed by the transmittal.

A list of any documents attached to the transmittal.

- A contract change log containing the following information for each required change in any requirement:

An identifying number.

References to documentation of the change.

A list of the affected contract sections.

A concise summary of the change.

Cost and schedule information.

Status of the change

- Project Issues and Risk Log, containing issues and risks that could threaten the goals and timetables of any aspect of HES project. Each entry shall include:

An identifying number.

Date it was raised and who it was raised by.

A description of the issue/risk and potential impact.

Severity.

Probability.

Status.

Who it is assigned to and due date.

A brief description of the mitigation strategies, contingencies, plans adopted, etc.

13.3.4. Project Meetings, Agendas, and Minutes

Project meetings shall be held to review project progress, to ensure correct interpretation of the contract, to review technical and commercial issues, and to maintain co-ordination between Employer and Supplier.

Meetings shall be held at appropriate times, but shall be scheduled every three months on average. The initial two meetings shall be scheduled within two months of each other.

Formal meetings shall be augmented with teleconferences and informal meetings as required.

The Supplier's project manager shall prepare a meeting agenda in time for review by Employer before the meeting.

The Supplier's project manager shall prepare minutes of each meeting.

- Both Employer and the Supplier shall review and approve the minutes.
- The approved minutes shall be considered binding agreements, subject to concordance with the contract.
- Where the approved minutes conflict with the contract, the minutes shall be revised.
- Where the minutes of a meeting conflict with the approved minutes of a previous meeting, the conflict shall be documented in the later minutes and those approved minutes shall have precedence.

Supplier shall be responsible for the travel and living costs while attending Project Meetings at the Employer's site

Travel and living costs for training in Vietnam shall be at the cost of the Supplier.

13.3.5. Project Correspondence

All requests and transfers of information between the parties shall be made in writing, and shall be documented with letters of transmittal.

All correspondence from each party shall be dated (with the date of transmittal, not the date of writing) and uniquely numbered.

Each letter or other project correspondence shall be limited to a single topic to simplify correspondence management with the exception of the meeting minutes.

Correspondence transmitted via e-mail shall be considered as formal correspondence if it includes a transmittal number and an electronic "letter of transmittal".

All project management documentation, such as, correspondence, memos, meeting minutes, and monthly progress reports, shall be produced using the Microsoft Office productivity suite.

A mutually agreeable correspondence numbering scheme shall be developed and used to minimise file storage and retrieval efforts.

Employer and the Supplier shall agreed on officials e-mails addresses for the project on both sides.

13.3.6. Detailed Implementation Schedule

The Supplier shall submit for Employer approval a detailed implementation schedule.

The detailed implementation schedule shall describe all the project activities of both the Supplier and Employer.

The Supplier shall use the Microsoft Project application program to maintain the project schedule.

- This project management application shall be used to track the progress of the project from start through completion.
- Schedule monitoring shall be based on a comparison of completed tasks versus scheduled tasks and estimation of the required effort to complete the remaining tasks.

- The schedule presented to Employer shall be that used by the Supplier to manage their internal resources.

For a project of this scope, the project schedule the Supplier submits to Employer shall meet the following requirements:

- No single project task shall have a defined duration greater than 2 weeks (i.e., such tasks shall be broken into subtasks).
- Tasks shall be labelled as either complete or not complete (i.e., no use of the “% complete” feature).
- All tasks shall indicate personnel resource requirements by role.
- Pertinent tasks for Employer (e.g., database deliveries, document approvals, testing, etc.) shall be shown.
- Named resources shall be assigned (and leveled) for all Supplier tasks beginning in the next 4 weeks.

Supplier shall note and consider in the schedule any of Employer constraints regarding cutover or commissioning activities (cannot be scheduled during pre-designated periods of time due to, e.g., anticipated peak load or severe storm activity).

13.4. Testing, Shipment, and Commissioning

The transition of activities from the implementation of meters, communication network and HES in the Supplier's facilities through testing, shipment, installation, and commissioning is crucial to the success of the project. This section sets out the sequence of these activities and expands on the responsibilities of Employer and the Supplier for these activities being applied during implementation.

13.4.1. Authorisation for Shipment

Shipment will not be authorised until all variances have been corrected to Employer satisfaction.

- The Supplier shall submit an official notice of intent to ship at least one month prior to expected completion of the factory test.
- The notice shall indicate the contents, names of all carriers, estimated shipping weight, size of shipment, insurance provisions, date scheduled to leave the factory, and estimated date and time of arrival at Employer facilities.

Employer reserves the right to delay shipment if this notice is not given by the required time. Such delay shall be completely to the account of the Supplier – no schedule or cost relief will be granted.

Supplier shall inform Employer of the final shipping arrangements, including appropriate tracking numbers, once the shipment has occurred.

13.4.2. Change Control

The Supplier shall establish and document a methodical process of change control and configuration management for identification, control and reporting of any changes to HES software, documentation, and hardware components after shipment to Employer site.

At the conclusion of the system installation task, all meters, communication network and HES documentation (including configuration drawings), test plans, results, and sample data shall be updated to reflect the current state of the delivered systems.

- The final test plans will be the basis for the testing component of the change control procedures used to test and verify changes implemented either by the Supplier or Employer during the life of the system.

13.4.3. System Installation

After the equipment is delivered to the Employer site and received by Employer, meters, communication network and HES installation activities shall commence:

- Movement and placement of the equipment.
- Interconnection of the equipment, including interconnection with previously delivered equipment.
- The installation test.

The Supplier shall be responsible for these tasks, using labour provided by itself.

Prior to delivery to Employer site, the Supplier shall meet with Employer to discuss the work necessary to install meters, communication network and HES at specific site.

The Supplier shall become familiar with Employer labour and safety rules governing the installation work and shall design the installation work in accordance with these rules.

The Supplier shall work with the Employer to develop an optimal installation sequence closer to the actual delivery date.

13.4.4. Commissioning

Commissioning meters, communication network and HES shall start immediately after the successful completion of the respective installation test.

- Prior to commencing the commissioning, the Supplier shall update all databases within HES so that it is synchronized with the respective existing systems in the field.

Commissioning activities shall include but are not limited to the following:

- Checking that the on-site operation of the meters, communication network and HES.
- Verification of all HES interfaces with Supplier-provided data sources and systems.
- Validation of System databases and reports using real data. This shall include
 - Verification of the correctness of database, a successful spot check is needed subsequent to the resynchronisation activity.
 - Tuning of all applications as they apply to a specific HES.
- Validation of the output of HES functions using field data.

Supplier shall be responsible for this activity, with support from the Employer.

The project schedule shall allow sufficient time for this activity. The Supplier shall develop in detail to the satisfaction of the Employer, the tasks that will be part of the commissioning of the HES and the commissioning of HES functions as an integrated system.

The Supplier shall allocate a minimum of two people full-time at Employer site throughout this activity.

13.4.5. Site Acceptance Test

The site acceptance test shall be started after installation and Employer field update activities are complete.

Supplier shall be responsible for this activity, with support from the Employer.

13.4.6. Availability Test

The availability test shall be started after HES has been put on-line into production, all variances have been corrected, and the availability test prerequisites have been completed to Employer satisfaction.

Employer shall be responsible for this activity, with support from the Supplier.

13.4.7. Operational Acceptance

After the meters, communication network and HES successful completion of the corresponding final Availability Test, correction of all discrepancies, delivery and approval of all documentation to Employer satisfaction and replenishment of the spare parts by the Supplier, the Employer will formally notify the Supplier of Acceptance by issuing the corresponding the meters, communication network and HES Operational Acceptance Certificate.

The acceptance of the meters, communication network and HES will be achieved through the issuance of Operational Acceptance Certificate for the meters, communication network and HES, and an Operational Acceptance Certificate for the total System.

Employer will issue HES Operational Acceptance Certificates.

After successful completion of the final Availability Test with the meters, communication network and HES operating in its complete configuration with all functions tested and fully operational, correction of all discrepancies, delivery and approval of all documentation to Employer satisfaction and replenishment of the spare parts by the Supplier, Employer will formally notify the Supplier of the meters, communication network and HES Acceptance by issuing the meters, communication network and HES Operational Acceptance Certificate.

13.4.8. Final Acceptance

After successful completion of the meters, communication network and HES Warranty Period, correction of all discrepancies, delivery and approval of all documentation to Employer satisfaction and replenishment of the spare parts by the Supplier, Employer will formally notify the Supplier of the meters, communication network and HES Final Acceptance by issuing the Final Acceptance Certificate.

14. SYSTEM MAINTENANCE, EVOLUTION AND UPDATE RENOVATION - EVERGREEN PROGRAM

14.1. Objectives

Employer will consider the adoption of a tailored system maintenance, evolution, software assurance and renovation (“Evergreen”) program that guarantees the support of Employer needs throughout the HES lifecycle, considering the possible additional needs and the continuous evolution of the information systems technologies.

- The complete or partial adoption of the strategy and the specific options that are selected by the Employer will be subject to negotiation.

The Evergreen objectives can broadly be described as:

- Establish a strategy, conditions and directives for a continuous long-term relationship between Employer and the Supplier;
- Maintain the system as close as possible to the Supplier Baseline offering and future evolutions;
- Maintain 3rd party software (OEM software like operating system, data base management system, historian information system, etc.) up to date;
- Maintain the HES system in optimal operating condition and free of known errors, defects and security vulnerabilities, via preventive and corrective maintenance both from factory and local support;
- Maintain the HES appropriately sized in relation to the performance needs of Employer users, e.g. permanently available to perform their functions with the performance required by the users;
- Supplying the Employer access to updated tools and enhancements;
- Avoid obsolescence of the Hardware and Software platform;
- Maintain Employer personnel with the adequate level of knowledge for reliable system maintenance and system operation;
- Take advantage of the constant evolution of software and hardware for keeping the system “state of the art”, avoiding or postponing the need of a “forklift replacement”;
- Optimize (reduce) the total cost of ownership over long term operation;
- Preventive instead of corrective approach to maintenance;
- Ensure adequate response times to Employer requests for maximizing availability of its mission critical real-time platform;
- Allow Employer to develop and integrate onto HES, future applications developed by Employer or by third parties;
- Allow Employer to influence the product evolution of the Supplier.

14.2. Scope of Supply

The Evergreen program is comprised of a set of **maintenance, evolution services** and **software assurance** strategies as well as **system renovation services** intended to maintain

the HES in adequate operational conditions and technologically updated along its entire life cycle while reducing the total cost of ownership. This strategy and the services as well as the conditions are detailed later in this section.

The Evergreen program embraces the complete supply including the development and integration services, the Supplier and third party software licensing, the Supplier customised and specially developed software, and equipment.

Service	Applies to:	Summary of Coverage	Pre Final Acceptance	Post Final Acceptance¹ (Subject to negotiation)
Maintenance Program	OEM Hardware	Preventive/corrective	Included	Included
	Supplier Hardware	Preventive/corrective	Included	Included
	OEM Software	Preventive/corrective	Included	Included
	Supplier Software	Preventive/corrective	Included	Included
S y s t e m Evolution Services	Software evolution	Annual pool of hours	Excluded	Included
S o f t w a r e Assurance	OEM Software	Update/Upgrade	Excluded	Option
	Supplier Software	Update/Upgrade	Excluded	Option
S y s t e m Renovation	Supplier System software update	included	Excluded	Option (annual fee)
	H a r d w a r e replacement/upgrade	additional	Excluded	Option

Note 1: For the Duration of the Warranty period

System Maintenance Program

System Maintenance services are defined as the Supplier and Third Party hardware and software maintenance interventions, replacements, modifications, fixes, patches, updates, and if necessary customisation services that shall ensure that the system continues to operate according to the contracted requirements. These services shall include preventive and corrective actions. Corrective actions are those that arise as a consequence of system errors, failures, vulnerabilities, performance or operational shortfall. Preventive actions are those that reduce the probability of needing corrective actions. The Services shall be subject to the SLA outlined in [Appendix 11.A](#).

These services shall be provided as part of the contracted Warranty services and available as an option as a part of a Maintenance service agreement that would begin after the end of the Warranty period ([see item 11.4.5, Maintenance after Warranty](#)).

If system updates, upgrades or replacements are required in order to fix or correct any issues covered by the Warranty/Maintenance, including the issuing of new licenses or supply of equipment, these shall be done without any additional cost to the Employer.

The Supplier shall routinely update the HES to incorporate any new versions of Third Party software in order to guarantee that at any given time the version of a Third Party software installed in the HES system is covered by OEM support.

System Evolution Services

The Supplier shall offer system evolution services in order to allow Employer to manage changing requirements, new Employer applications, new protocols, integration of new software versions or new hardware to keep the system technologically updated not due to a system correction (covered by maintenance services). This will be fundamentally achieved via a 320 hours of technical man-power to be used as and when the Employer desires on any of the systems included under the Contract. These services shall be pool able between systems and shall accumulate over the annual period where the unused hours will rollover to the following year (except at the end of the service contract at which time the hours will expire.). It is envisaged that the pool of hours will be used towards the Employers 'top' candidate changes and that the Supplier will quote hours to achieve each change for the Employer to select.

Software Assurance

The Supplier shall offer system update and upgrade services – *software assurance* services – which are conceived primarily as a continuous evolution process based on Supplier's system baseline evolutions and Third Party software (new releases and versions). Employer will contract these software assurance services under the understanding that the Supplier will assume the obligation to continually evolve its baseline system. Employer shall receive the licenses and media for these new versions (updates and upgrades) of the Supplier and Third Party software, and will have the right to install in the HES such new releases of the acquired system and applications. The new releases / versions that are considered relevant will be installed in the HES with the support of the Supplier (see items 11.6.1 and 11.6.2).

The Supplier shall guarantee that the new versions shall maintain backward compatibility with software that was developed or customised for the Employer. If any adaptation to developed or customised applications is required due to changes in Supplier baseline software or Third Party software supplied by the Supplier, this will be a Supplier's responsibility as part of this service without any additional charges to Employer.

When a system evolution is necessary due to new requirements by Employer, it may include new applications specifically customised for Employer or changes to previously customised applications. In such case these efforts will be supported by the Supplier man-power. New licenses of Supplier and Third Party applications and/or features that are not covered by the licenses and agreements as per the Contract, as well as equipment, which eventually could be required to satisfy such new requirements, shall be the subject of future negotiations with the Supplier.

If any new release or version includes new functionalities, the Supplier may offer the new functionality to Employer and justify it. Employer will not be obliged to acquire such new version if Employer has no interest or no agreement is reached. In such case the Supplier shall guarantee maintenance and system updates to the previous version until the end of Contract, or supply and implement the new version with no extra cost to Employer.

System Renovations

System Renovation is characterised as a complete replacement of hardware and/or software in order to bring the HES to a new technology stage. This will be performed when the continuous evolution process is not feasible to implement without substantial hardware and/or software changes. A possible driver for renovation is when the hardware needs to be replaced due to relevant technological changes in the Supplier Baseline system when, as an example, the Supplier baseline requires a new operating system not supported by the current hardware platform. Other drivers for system renovation could be the obsolescence of hardware.

The renovations includes among other services the porting of the Employer database into the latest data engineering database model, porting of Employer system and customised application displays into the new Baseline application display set, and porting of customised code into the new Baseline code. Each new release, based on the latest approved Baseline Supplier release, shall be built at Supplier' facility using Employer' configuration/sizing parameters. The backward compatibility requirement is also applicable.

At renovation time, hardware replacements will be specified and proposed by the Supplier and Employer will have the right of option to purchase directly from the Supplier or from Third Party OEMs approved by the Supplier.

Supplier's human resources that may be required shall be quoted as part of the renovation services. Part of the necessary services may be, at Employer's discretion, compensated by the Supplier man-power included in the Evolution services. At renovation time, additional services (if any) shall be justified and proposed by the Supplier for Employer analysis and approval.

The cost of Supplier and Third Party software licenses shall be already covered by the *Software Assurance* agreement (which includes software updates and upgrades) except for licenses covering new applications or new features specifically required by Employer that shall be proposed and justified by the Supplier for Employer analysis and approval.

A system renovation will require a project structure including specification, design, development, quality assurance and testing, commissioning, migration (cutover), documentation and training services. The hardware, software, database and displays shall be tested at the Supplier factory, and then installed at Employer's sites. On-site tests of the renovated system shall be performed after the installation is complete and cutover can be performed. This effort will be carefully coordinated with Employer to minimise any disruption of the on-line systems operation.

System renovation as an option shall be subject to an annual fee with the renovation occurring after the completion of Warranty.

14.3. Definitions

The following definitions will be used:

- Delivery – Delivery of any item shall be interpreted as receipt of the item at the Employer's facility.

- Commissioning – Commissioning of any item shall be interpreted as receipt of the item at the Employer's facility, installation on-site, successful completion of the site tests, and correction of all variances from the tests.
- System Updates – Updates are defined as the system modifications to the current and new versions of the product which shall correct errors, vulnerabilities or latent problems (example: update of drivers, operating system and anti-virus, and application of patches, fixes, service packs, and engineering changes, etc.) and improve usability, in order to maintain and may improve the supplied system. The update services aim to keep the system free of known errors and vulnerabilities, and current with the Supplier's and third parties software technology advances. Regarding the hardware, updates may include new drivers, engineering changes, etc.
- System Upgrades – The upgrades are understood as new versions that include improvements in the Supplier and/or Third Party software Baseline features, and may include new functionalities. Additional functionalities that are not part of the initial contracted supply may be offered by the Supplier and/or added to the Employer HES system per specific request of Employer.
- Software assurance – the software assurance services are defined as a set of services intended to maintain system software current with the most recent releases of software from the Supplier and Third Parties. According to this agreement the Supplier will deliver to Employer all new releases (updates and upgrades) of their Baseline software products and other system software versions including Third Parties for those licensed Supplier applications. This includes the Baseline and other applications executable, database, release notes, and documentation. It also includes access to updates, patches and fixes to those licensed applications.

14.4. General Requirements

Responsibility and requirements for the maintenance, evolution and software assurance of the System hardware and software will be consistent during the HES lifecycle (including renovation). Besides the basic responsibilities which will apply to the whole period, additional requirements shall be applied to each specific service, as defined below.

The Supplier shall be responsible for the maintenance services applied to all supplied equipment and software in compliance with the SLA (refer to Appendix 11.A) from the start of the Availability Test through the contract period, including: standard Supplier software; standard Supplier software customised for Employer; standard third part software; software developed specifically for Employer by the Supplier; and hardware.

Through to the end of the Warranty Period, the Supplier's technical support staff shall work with Employer's technical staff to establish a strategy to efficiently resolve each identified problem.

- If at any time, Employer believes that the Supplier's technical support is not effectively resolving a problem, Employer may request the Supplier's staff or staff from the OEM or Third Party software provider to be dispatched to the Employer's facility.
- The Supplier's technical team shall be at the Employer's facility within 24 hours of Employer request to provide hands-on support towards the problem resolution. During all the contract period (including the Availability tests) whenever maintenance is

rendered, Employer shall not be responsible for any additional expenses connected to the technical support related to system maintenance and correction services, including travel expenses.

The Supplier shall maintain in Vietnam, installations with appropriate and qualified teams for the migration, test, maintenance and support activities during Commissioning, Site and Availability Tests, and as required by Maintenance, Evolution and Software Assurance agreements. This requirement can be met directly by the Supplier facilities and staff or by a qualified subcontractor previously approved by Employer. Employer reserves the right to inspect these resources prior to starting any period of the project or confirm or extend any contract term as applicable.

14.4.1. Deliverable Version

The delivered hardware shall be the latest version being delivered by the manufacturer of the hardware at the time of delivery to the Supplier's facility. Prior to the procurement of hardware, the Supplier shall submit to Employer a complete updated list of all proposed hardware with a statement of the respective equipment lifecycle supporting this requirement.

The delivered software shall be the latest version certified to execute on the Supplier's platform. In no event shall any third party software be more than one version beyond the current version. Prior to the procurement of software, the Supplier shall submit to Employer a complete updated list of all third party software with a statement of the respective software lifecycle supporting this requirement.

- If it becomes necessary to upgrade some hardware or software to meet the requirements specified in item and above, the cost and time shall be borne by the Supplier. All modifications performed after FAT shall be retested. All design modifications of any part of the HES shall be approved by Employer.

Employer and the Supplier may, by mutual agreement, elect to upgrade hardware or software later than the term set above.

All hardware and software shall be of compatible versions.

- The Supplier shall be responsible to ensure that all delivered hardware and software versions will inter-operate successfully.
- If it becomes necessary to upgrade some hardware or software to meet this requirement, the cost and time shall be borne by the Supplier.
- If it is necessary to revert to a previous version of any hardware or software to overcome incompatibilities among the hardware or software, the Supplier shall bear the cost and time of the "downgrade" and shall present a plan to correct the problems with the newer release. Such corrections shall also be at the Supplier's sole expense.

As a continuous activity, the Supplier shall investigate and inform Employer all hardware and software patches, fixes or available updates with security or stability implications during the whole Contract period. This requirement shall be especially emphasised when the system is in operation and prior to the start of Site Acceptance Tests. This shall conform to [Appendix 11.B in item 11.B.2.](#)

- Employer and the Supplier may, by mutual agreement, elect to perform such hardware or software updates prior to the start of the respective test.

- The cost and schedule for such upgrades shall be determined at the time the upgrade is elected.

14.4.2. Hardware Maintenance

The Supplier shall be responsible for the maintenance of Hardware included in the scope of supply for the duration of the contract including to the completion of the warranty period. All equipment, spare parts and replenishments required for maintenance shall be included in the Contract. The performance conditions for the Hardware maintenance are established in the Service Level Agreement – SLA (refer to Appendix 11.A). Additional requirements for system security are described in Appendix 11.B – System Security for Maintenance.

General use hardware (like servers, workstations, storage arrays, network equipment, etc.) to be part of the supply shall have full support in Vietnam. This means that the HES equipment shall have the original manufacturer technical expertise and support as well as spare parts available in Vietnam. Specific hardware (like for example the Time and Frequency System) is not subject to this requirement.

Employer will be responsible for the first level support of hardware and software, including the use of spare parts in any hardware device, and for notifying the Supplier of any problem. The Employer responsibility is limited to the performance of operational and maintenance documented procedures as explicitly specified and mutually agreed by Employer and the Supplier. The action of Employer team does not exempt the Supplier of any responsibility for hardware and software maintenance in compliance with the SLA and other requirements defined in the Contract.

The Supplier shall maintain an incident diagnostics and evaluation service that will support Employer in the maintenance activities. A log of all events and maintenance actions, assigned personnel, as well as time relevant information i.e. expected solution time, shall be maintained. A web supported tool shall be maintained by the Supplier for this purpose. Employer authorised personnel shall have access to this site.

If the Supplier recommends that hardware is to be maintained by the original equipment manufacturer or other parties under subcontract to the Supplier, this will be acceptable to Employer only if the following requirements are met:

- the maintenance subcontractor is located within four hours of each of the Employer's facilities,
- subcontractor has previous experience with maintenance of the hardware,
- subcontractor maintains a reasonable stock of spare parts, and
- subcontractor has agreements in place for expedited delivery of spare parts not in their inventory.

14.4.2.1. Spare Parts, Tools, and Test Equipment

The Supplier shall recommend and supply on-site spare parts for field-replaceable and field-repairable modules for equipment as part of the list of deliverable hardware in order to guarantee the compliance with the SLA.

The spare parts to be supplied shall be adjusted by the Supplier during the project so that the delivered set is consistent with the delivered System configuration. This requirement shall persist during the Contract term.

The recommended spare parts shall include any special tools and test equipment that the Supplier and the OEM use and which are applicable for Employer's maintenance.

If a part that is not in the on-site spares is needed to replace a failed system component, the Supplier shall replace the faulty unit and add four more units to the spare parts at no cost to the Employer.

14.4.2.2. Hardware Minimum Support Period

The Supplier shall guarantee the availability of spare parts and hardware maintenance services for all System equipment until the end of the Warranty

14.4.3. Software Maintenance

The term “software” shall include all firmware and software delivered under this Contract, as well as the associated configuration files, installation kits, release media, documentation, and support media such as on-line help facilities and maintenance tools.

The project schedule shall include an allowance for software maintenance prior to the availability test.

- The Supplier will not be granted any relief for project delays caused by maintenance problems prior to the availability test.

The System software will likely be composed of Supplier's standard system elements, customised or specially developed elements, and several third party products.

- In order to facilitate the efficient maintenance of the System software, the Supplier shall follow a general philosophy of software implementation which guarantees the clear segmentation and identification of standard software and Employer customized software. This principle shall ensure that changes and upgrades to the Supplier's standard system software, applications, or third party products can be implemented without affecting or interfering with the software specific to Employer.
- The Supplier shall guarantee portability between customized software and new releases of standard software.

The Supplier shall be responsible for the maintenance of software included in the scope of supply during the duration of the Contract to the completion of warranty.

- The Supplier shall maintain an incident diagnostics and evaluation service that will support Employer in the system maintenance activities. A log of all events and maintenance actions, assigned personnel, as well as time relevant information i.e. expected solution time, shall be maintained. A web supported tool shall be maintained by the Supplier for this purpose. Authorized personnel shall have access to this site.

Employer will be responsible for the first level support of software, and for notifying the Supplier of any problem. The Employer responsibility is limited to the performance of operational and maintenance documented procedures explicitly specified within the System Maintenance manual. The actions of Employer teams does not exempt the Supplier of any responsibility for software maintenance in compliance with the SLA and other requirements defined in the Contract. These procedures shall be part of the training as per the Training section in this Specification and the Contract.

The conditions for the Software maintenance are established in the Service Level Agreement – SLA (refer to Appendix 11.A) as part of the Contract. Additional requirements for system security are described in Appendix 11.B – System Security for Maintenance.

14.4.3.1. Right to Change Software

Employer shall have the right to alter, modify, edit, and add to all software provided with the HES except for third-party standard general use software.

- This right shall begin with the Supplier’s baseline software. This requirement is necessary to facilitate development of Employer-supplied software and the interfaces to the other Employer’s computer systems. This right shall survive the Contract agreement.
- Employer agrees to discuss any changes to be made to software no less than 48 hours in advance of the implementation of the change, having in mind that the Supplier is responsible for the maintenance, compatibility and integration of the HES.

14.4.3.2. Software Minimum Update Period

The Supplier shall guarantee the availability of technical update service for all System software, and shall communicate to Employer all software releases applicable to the system for a minimum period of three years beyond the end of the HES Contract between Supplier and Employer.

Subsequent to this minimum support period, the Supplier shall provide to the Employer a minimum of one year's advance notice of their intent to terminate such service.

14.4.4. Warranty

The Supplier guarantees that, once the final system Acceptance Certificate has been issued, the meters, communication network and HES represent a complete, integrated solution to the Employer’s requirements set forth in the Contract.

- If, for reasons attributable to the Supplier, the meters, communication network and HES do not conform to the Technical requirements defined in the Contract or do not conform to any other aspects of the Contract, the Supplier shall at its cost and expense make such corrections, changes, modifications, and/or additions to the System as may be necessary to conform to the Requirements and meet all functional and performance standards. The Supplier shall notify Employer upon completion of the necessary corrections, changes, modifications, and/or additions and shall request Employer to repeat the Acceptance Tests until the meters, communication network and HES achieves acceptance.

14.4.4.1. Warranty Period

“Warranty Period” means the period of validity of the warranties given by the Supplier as part of the project implementation (and renovations) commencing at the date of final acceptance of the HES, when the Operational Acceptance Certificate (AC) is issued by Employer. During this period the Supplier is responsible for defects with respect to the System (or the relevant Subsystem[s]).

The Warranty Period shall implemented within **thirty six (36) months**.

During the Warranty Period, the Supplier shall commence the work necessary to remedy defects or damage within the timeframe.

14.4.4.2. Warranties

The Supplier shall warrant that the Employer including all information technologies, materials, and other goods supplied and services provided, shall be free from defects in the design, engineering, materials, and workmanship that prevent the meters, communication network and HES and/or any of its components from fulfilling the technical requirements or that limit in a material fashion the performance, reliability, or extensibility of the System and/or Subsystems.

The Supplier shall also warrant that the information technologies, materials, and other goods supplied under the Contract will be new, unused, and incorporate all recent improvements in design that materially affect the meters, communication network and HES' ability to fulfil the technical requirements.

14.4.4.3. Correction of Defects

If during the Warranty Period any defect (including cyber vulnerabilities) shall be found in the design, engineering, materials, and workmanship of the supplied HES or of the Services provided by the Supplier, the Supplier shall promptly, in consultation and agreement with Employer regarding appropriate remedying of the defects, and at its sole cost, repair, replace, or otherwise make good (as the Supplier shall, at its discretion, determine) such defect as well as any damage to the HES caused by such defect. Any defective items that have been replaced by the Supplier will be the property of the Supplier.

- The Supplier shall not be responsible for the repair, replacement, or making good of any defect or of any damage to the HES arising out of or resulting from any of the following causes:
 - Improper operation of the HES by Employer;
 - Normal wear and tear;
 - Use of the HES with items not supplied or specified by the Supplier, unless otherwise identified in the technical requirements, or approved by the Supplier; or
 - Modifications made to the HES by Employer, or a third party, not in compliance with documented procedures.

The Supplier shall commence the work necessary to remedy such defect or any damage to the HES caused by such defect in accordance with the SLA.

- If the Supplier fails to commence the work within the time period specified in the above item, Employer may, following notice to the Supplier, proceed to do such work or contract a third party (or parties) to do such work, and the reasonable costs incurred by Employer in connection with such work shall be paid by the Supplier or may be deducted by Employer from any monies due to the Supplier.
- If the HES or any Subsystem cannot be used or has any critical function unavailable by reason of such defect, exceeding the time period allowed in the SLA, the time count for Warranty will hold and the Warranty Period shall be extended by a period

equal to the period during which the HES or Subsystem could not be used by Employer because of such defect.

Items replacing defective parts of the System during the Warranty Period shall be covered by the Warranty for the remainder of the Warranty Period applicable for the part replaced or **thirty six (36) months**, whichever is greater.

At the request of Employer and without prejudice to any other rights and remedies that Employer may have against the Supplier under the Contract, the Supplier shall offer all possible assistance to Employer to seek maintenance and repair services or remedial action from any subcontracted third-party suppliers included in the HES, including, without limitation, assignment or transfer in favour of Employer of the benefit of any warranties given by such suppliers to the Supplier.

14.4.5. Maintenance after Warranty

The Supplier shall offer maintenance services after the end of the Warranty period.

All technical requirements and considerations as above referred for the Warranty period shall also apply to the Maintenance after Warranty.

If the HES or any Subsystem cannot be used or has any critical function unavailable by reason of defects, exceeding the time period allowed in the SLA, the corresponding maintenance contract penalties shall apply.

14.5. Services during Project Implementation

14.5.1. Hardware Maintenance

14.5.1.1. Pre-Delivery Maintenance

The Supplier shall have the responsibility for maintenance of all equipment prior to delivery to the Employer's site.

- This maintenance may be performed by a maintenance contract with Original Equipment Manufacturers (OEMs) or other parties or by the Supplier staff using spare parts from the Supplier's stores or other sources.
- The Supplier shall preferably not use spare parts to be delivered to Employer for this maintenance. In case some Employer spare parts are used for the maintenance, the Supplier shall replenish the spares inventory within a maximum of three weeks.

14.5.1.2. Maintenance prior to Commencement of the Availability Test

The Supplier shall have the responsibility for maintenance of all equipment included in his supply after delivery and prior to commencement of the availability test.

- This maintenance may be performed by a maintenance contract with OEMs or other parties or by Supplier staff using spare parts from the Supplier's stores or other sources.
- The Supplier shall preferably not use spare parts to be delivered to Employer for this maintenance. In case some Employer spare parts are used for the maintenance, the Supplier shall replenish the spares inventory within three weeks. The Supplier will be

responsible for any problem or delay eventually caused by the use of Employer spare parts.

- If the Supplier or Employer is unable to repair an item due to the Supplier's failure to recommend spare parts for that item, the Supplier shall provide a replacement part and a sufficient quantity of spares for the item at no cost to Employer.

Failed equipment shall be replaced or repaired and spares inventories replenished to their delivered level throughout the period of commissioning.

Any spare parts found to be defective during initial delivery inspection or during this period shall be replaced within three weeks after notification.

- There shall be no charges to Employer for these replacement parts, including delivery charges.
- All spare parts replaced under maintenance shall be new parts unless otherwise accepted by Employer.

14.5.1.3. Equipment Maintenance during Availability Tests

As system is already in operation during the Availability Test, the equipment maintenance shall follow the same requirements as during normal operation period and shall comply with the SLA requirements. See detailed requirements at item [11.6.1.1](#).

14.5.2. Software Maintenance

14.5.2.1. Pre-Delivery Maintenance

The Supplier shall have the responsibility for maintenance for all software prior to delivery. This maintenance may be performed by a maintenance contract with OEMs or other parties or by Supplier staff.

14.5.2.2. Maintenance prior to Commencement of the Availability Test

The Supplier shall have the responsibility for maintenance of all software during the Contract period.

- This maintenance may be performed by a maintenance contract with OEMs or other parties or by Supplier staff, previously approved by Employer. The actions of OEMs or other parties do not exempt the Supplier on any responsibility regarding maintenance as specified in the SLA and other contractual requirements.
- Employer will support the Supplier providing first-level maintenance as defined in [11.4.3](#). Employer will also notify the Supplier about any problem requiring attention.
- This responsibility is limited to the execution of the defined operation and maintenance procedures that have been detailed by the Supplier. The intent is to ensure that the System Maintenance Manual provides appropriate coverage for system maintenance. The manual shall be augmented for any shortfalls in coverage. The actions of Employer do not exempt the Supplier of any responsibility regarding maintenance as specified in the SLA and other contractual requirements.

During the Commissioning period, Employer may make changes to databases, displays, and reports as necessary to meet Employer's operational needs. Also the Supplier may make changes to software or data.

- Employer agrees to inform Supplier of all such changes at least 24 hours prior to installation of the changes. Also the Supplier will notify Employer about such changes with the same anticipation.
- If the Supplier (or Employer) believes that the changes may adversely affect the operation of software for which the Supplier (or Employer) is responsible, Employer (or the Supplier) shall be notified of the potential problem and the changes shall be reviewed.
- Both parties shall work towards a mutually agreeable implementation of the desired changes.

14.5.2.3. Software Maintenance during Availability Tests

As system is already in operation during the Availability demonstration, software maintenance shall follow the same requirements as during normal operation period and shall attend the SLA requirements. See detailed requirements at item [11.6.1.2](#).

14.6. Services during System Operation through to the completion of Warranty

14.6.1. Maintenance Services

While the HES system are in operation, (also including the availability test period), the Supplier shall maintain the following maintenance services:

- 24/7 Hot-Line Service access, in conformity with the SLA, supporting the Vietnamese Language.
- A track record of response times to attend Employer requests and the response time to replenish equipment spare parts shall be maintained.
- The Supplier shall comply with all terms and conditions set forth in the Service Level Agreement (SLA) included in [Appendix 11-A](#).

All travel expenses for maintenance services shall be the responsibility of the Supplier.

14.6.1.1. Hardware Maintenance

Hardware Maintenance under Warranty and after Warranty period shall be in conformance with the terms of the Technical Specification including the SLA. All requirements of this item also apply to the availability test as stated in [11.5.1.3](#).

Where the Supplier elects to subcontract the maintenance to a third party, previously approved by Employer, the maintenance subcontractor shall meet the requirements set forth in the Technical Specification including SLA. The actions of OEMs or other parties do not exempt the Supplier on any responsibility regarding maintenance as specified in the Technical Specification including SLA.

During the maintenance period, the Employer' hardware maintenance responsibilities will include the following:

- Provision of trained staff, responsible for call-out when problems occur.

- Performing preventive maintenance, performing first-level corrective maintenance and installing engineering changes on equipment. Employer will notify the Supplier of any problem requiring Supplier's attention.
- Providing local assistance to the Supplier during problem resolutions.
- This responsibility is limited to the execution of the operation and maintenance procedures that have been explicitly agreed between Employer and the Supplier. The actions of Employer do not exempt the Supplier of any responsibility regarding maintenance as specified in the Technical Specification including the SLA.

If Employer is unable to repair an item due to the Supplier's failure to recommend spare parts for that item, the Supplier shall provide a replacement part and a sufficient quantity of spares for the item at no cost to Employer.

The Supplier' hardware maintenance responsibilities shall include the following:

- Providing maintenance of equipment, including spare parts not initially provided or replenishment according to the Technical Specification including SLA.
- Providing materials and instruction for appropriate engineering changes for equipment.
- Provision of technical guidance towards the resolution of all hardware problems for all equipment.

When needed, the Supplier shall respond to requests for technical support according to the Technical Specification including SLA; either via on-site visit or remote diagnostic access via a secure connection.

Failed equipment shall be replaced or repaired and spares inventories replenished to their delivered level throughout this period.

- Any spare parts found to be defective during initial delivery inspection or during maintenance and evolution period shall be replaced within three weeks after notification and shall attend the SLA.
- There shall be no charges to the Employer for these replacement parts, including delivery charges. All defective parts shall be picked up by the Supplier from Employer premises.
- All spare parts replaced under maintenance shall be new parts unless otherwise accepted by Employer.
- The failure to replenish the spare parts stocks will not exempt the Supplier from attending the SLA terms and conditions.

14.6.1.2. Software Maintenance

Software Maintenance under Warranty and after Warranty period shall be in conformance with the terms of the Technical Specification including SLA. All requirements of this item also apply to the availability test period as stated in [11.5.2.3](#).

The Supplier shall have the responsibility for maintenance for all supplied software, according to the Technical Specification including SLA.

- This maintenance may be performed by a maintenance contract with Third Parties or by Supplier staff, previously approved by Employer. The actions of other parties do not exempt the Supplier on any responsibility regarding maintenance as specified in the Technical Specification including SLA.
- Regarding Third Party software such as the operational systems (Unix, Windows, Linux, etc), Database Management System (Oracle, MS/SQL Server), antivirus, firewall, backup and archiving and other similar software, the Supplier shall establish a maintenance support and evolution agreement (“software assurance”) with the Third Party software vendors with adequate SLA level according to the requirement of Employer SLA as specified in item 11.6.3. At the appropriate time the Supplier shall demonstrate to Employer that these agreements are in place. Employer may at its discretion opt to have such software support and evolution agreements directly with the Third Party vendors.
- Employer shall have the responsibility for first-level maintenance for all software during the Warranty as part of the maintenance and evolution period and its extensions. This responsibility is limited to the execution of the specified operation and maintenance documented procedures that have been object of training and explicitly agreed between Employer and the Supplier. The actions of Employer do not exempt the Supplier on any responsibility regarding maintenance as specified in the SLA and other contractual requirements.
- Employer will also notify the Supplier about any problem requiring attention.
- Provision of technical guidance towards the resolution of all software problems.

During the maintenance and evolution period and its extensions, Employer may make changes to databases, displays, and reports as necessary to meet Employer's operational needs.

- Employer shall be under no obligation to inform the Supplier of such changes.

The Supplier shall provide summaries of all changes made to software, including but not limited to security updates, performed during the maintenance period of support. These summaries shall describe the problem and solution for any maintenance action performed.

The Supplier shall monitor all updates to software that are released during the maintenance period, and shall advise Employer as to the applicability of the updates to the delivered HES.

- Employer shall support the Supplier by performing first-level maintenance of all software during the maintenance and evolution period and its extensions, and will install the updates after considering the advice of the Supplier.

14.6.2. Evolution Services

The following is the list of the required support services:

- Evolution 72 hours man-power support for HES per month, in addition to any maintenance effort, preferably using Supplier’s qualified staff. This man-power may be applied towards technical services for integration of new applications, development of customizations and improvements, training, consultation or any combination thereof. The additional hours that come to be necessary shall be supplied according to the agreed per-hour rate.

Rollover Provision: Hours are pool able and any unused hours at the end of the year, may be rolled over to the following year for future use, as decided by Employer.

Any hours remaining at the end of the service contract shall expire.

- Annual subscription to Supplier’s web-based problem reporting system and the Customer Bulletin Board.

Any new applications that will be integrated after system acceptance shall be completely tested and commissioned. Adequate documentation and training shall be provided for the new applications.

Technical services that require the remote communication from Supplier’s facilities shall be using a secure connection

- The remote access costs referring to telecommunications are at the expenses of the Supplier.

14.6.3. Software Assurance Services

The services shall include a Software Assurance agreement – providing access to system updates and upgrades – to be performed during the Evergreen Services Contract period after HES Acceptance, in order to keep the system current with the Supplier Baseline and Third Party software versions.

Employer shall have rights of use for all new releases of the Baseline software products and other system software versions including Third Parties for those licensed applications, under the Software Assurance agreement. This includes the Baseline and other applications executable, database, release notes, documentation and support. It also includes access to updates, patches and fixes to those licensed applications.

- The payments (if any) to Third Party software vendors shall be separately accounted in the Software Assurance agreement. The Supplier shall include in the services agreement, any technical conditions and value of the fees to be pre-paid, on an annual basis.

The Supplier shall make available to Employer, for testing, all new developed versions of the baseline system. This software may be installed by Employer with Supplier support (as per item 11.6.2) and documentation.

New versions, after approval to be installed in the production HES platform, shall be built using Employer’s configuration/parameters. The software, database and displays shall be tested in the factory. A final site test of the new system shall be performed after the installation is complete. This effort shall be carefully coordinated with Employer to minimise any disruption of the on-line systems operation. Also given the complexity of the Employer HES system the Supplier shall present a well defined plan for testing and implementing the upgraded versions proceeding site by site thus reducing the impact on Employer normal operations.

Supplier shall provide warranty for the upgraded/updated versions when implemented in the HES production platform, in the same terms as for the main contract applicable so that at any particular time Employer system is covered by a comprehensive maintenance warranty.

For the implementation of a new software version the same requirements for documentation, testing, training and project implementation stipulated of this specification shall apply in all aspects that are relevant to the update/upgrade. In no case shall a not well proven software version be implemented at Employer. This migration effort and schedule shall be carefully coordinated with Employer to avoid any disruption of the on-line systems operation.

The system upgrade shall include as a minimum all functions that have been implemented in HES before starting the warranty period in their latest version.

The proposal shall consider the cooperation of Employer personnel in the specification, development and testing of system updates/upgrades. The participation of Employer personnel in OJT and testing activities in the Supplier site is estimated in 1 person for 1 month per year. Travel expenses will be borne by Employer.

The Supplier shall make available to Employer, for testing, all new developed application, not present in previously purchased versions into the operational platform of the baseline system. This software may be installed by Employer with Supplier support and documentation. These applications shall not be customised with the Employer configuration and parameterisation, and will be used by Employer solely for evaluation purposes. If Employer decides to implement such new application, an agreed cost of license, if any, shall be negotiated. The implementation may require the use of evolution man-power as per item 11.6.2.

14.6.4. System Renovation

Besides the previously mentioned upgrades and updates the Supplier shall include a complete system (hardware and software) renovation to be performed as part of the Evergreen program.

- The decision of when to make a specific hardware upgrade or renovation will be discussed by the Steering Committee where the Employer and Supplier project managers will decide, based on the audits or technical inspections and reports, if and when to proceed to implement the hardware modifications. Any equipment to be installed shall have better performance and/or functionality than the previously installed equipment.
- These renovations will not necessarily be simultaneous for hardware and software e.g. hardware and software may eventually be renovated separately.
- Employer may elect to perform hardware renovations step by step depending on what equipment is becoming obsolete or where the system requires more processing power due to the new software release needs, unexpected expansion, new functionality, etc.

Employer will keep the option to decide to purchase the Supplier proposed hardware or purchase the Supplier specified hardware directly from a Supplier recommended OEM. In any case the Supplier will have the complete responsibility of HES functionality and performance.

The Hardware and Software system renovation services shall include:

- Porting of the complete customer database into the latest data engineering database model,
- Porting of Employer's one-line diagrams into the display set,
- Porting of customized application displays (provided as part of the original system delivery) into the Baseline application display set, and

- Porting of customized code provided as part of the original system delivery into the Baseline code.

Appendix 11.A Service Level Agreement (SLA)

Table 111: Variance Priority Level

Variance Priority Level	Description
Critical	Critical Functions non-operational or unusable. Critical or material impact to the normal operations.
High	Critical Functions operational but without redundancy, and there are no possible circumventing actions.
Medium	<ul style="list-style-type: none">• Functions are operational but with limited functionality. There are no possible circumventing actions to prevent impacts to normal operation.• Non critical functions are not operational.
Low	Functions are operational but there are some identified problems that need correction. There are no impacts on normal operation.
SIR	Functions are operational. A change or improvement was identified and requested.

Table 112: Service Quality Levels per Variance Priority Level

Variance Priority Level	Maximum Response time	Maximum Solution time	Guidelines
Critical	2 h	6 h	A schedule for the correction of critical priority variances shall be informed within two (2) hours and it shall be fixed within six (6) hours after Employer request. After this period the Scaling Level shall be increased.
High	4 h	12 h	A schedule for the correction of high priority variances shall be informed within four (4) hours and it shall be fixed within twelve (12) hours after Employer request. After this period the Scaling Level shall be increased.
Medium	8 h	At the end of current working day	A schedule for the correction of medium priority variances shall be informed within eight (8) hours and it shall be fixed at the end of the working day of Employer request. After this period the Scaling Level shall be increased.
Low	2 working days	5 working days	The schedule for correction of all low variances shall be replied within two working days and it shall be fixed within five working days of Employer request.
SIR			Employer and the Supplier shall establish a mutually agreeable date for the correction.
Spare part replenishment	1 working day	3 weeks	Supplier shall initiate the provisions to replenish the spare part in the following working day after Employer notification and shall deliver the spare part within 3 weeks at Employer site.

Table 113: Table of Scaling Level according to Variance Priority Level

Scaling Level	Maximum Time from Employer request per Variance Priority Level			
	Critical	High	Medium	Low
Level 1	Until 6 hours to be solved	Until 12 hours to be solved	Until the end of the next working day	Until the end of the fifth working day
Level 2	8 hours	1 working day	3 working days	10 working days
Level 3	10 hours	3 working days	5 working days	15 working days
Level 4	12 hours	5 working days	7 working days	20 working days

Level 1: First Supplier Technical Level.

Level 2: Supplier Project Manager/Maintenance Manager scaling level. He/She will be in charge and can be called when the corresponding period in the above table is exceeded and the failure has not been fixed.

Level 3: Supplier General Manager/Superintendent scaling level. He/She will be in charge and can be called when the corresponding period in the above table is exceeded and the failure has not been fixed.

Level 4: Supplier Director/CEO scaling level. He/She will be in charge and can be called when the corresponding period in the above table is exceeded and the failure has not been fixed.

Note: Failure of the Supplier to meet the contractual terms and conditions will cause the first time it occurs the delay in any payments associated with the maintenance or service for a period of twice of the delay, in addition to all other contract penalty clauses.

Appendix 11.B – System Security for Maintenance

The following requirements are applicable for the Contract duration.

11.B.1 Security of Remote Access for Maintenance

All access from Supplier's facilities or Supplier's staff to Employer's HES for the purpose of maintenance shall be permitted during the Contract period and not to any component of the on-line HES. The Employer may authorise Supplier staff to access the real time environment purely on an as needs basis and under strict monitoring and control.

- Such access shall be subject to the security requirements for remote maintenance access.
- All actions performed remotely shall be subject to audit trail reporting and adhere to Employer software version and configuration control procedures.

The Supplier's diagnostic system used for remote maintenance of Employer's HES is referred to here as the "Supplier's remote diagnostic system".

- The Supplier shall ensure security of the physical access to Supplier's remote diagnostic system.
- The Supplier's remote diagnostic system shall be a stand-alone system, and shall not be connected to any Supplier or external network.
- Supplier shall enforce strict physical and electronic security procedures for access to the Supplier's remote diagnostic system, such as having the system in a secure area and requiring a smart card or biometric identification as well as a password to gain access to the Supplier's remote communications line.
 - The Supplier shall ask for permission for any remote access connection which shall be previously authorised by Employer.
 - Employer will have the right to block the remote access to the Supplier without previous advice if so necessary. In such case the Supplier shall send a maintenance team to the HES site as needed.
- Upon termination of the Contract, and since no further extension is agreed, the Supplier's remote diagnostic system shall be dismantled, and all paper and electronic media shall be securely erased or destroyed.
 - A certificate of erasure or destruction shall be provided as part of the contract termination documentation.

11.B.2 Installation of Security Patches

Whenever a software Supplier, including the meters, communication network and HES Supplier releases a software change ("upgrade", "update", "modification", "release", or "patch") to correct a security-related error in the code or to close a vulnerability, or system instability, the Supplier shall take immediate steps to test, confirm, and install the software change on the meters, communication network and HES.

- The Supplier shall develop and test security related software changes against a “base line” software environment in order to minimize the testing time required on Employer’s system(s).
- The Supplier shall notify Employer as soon as practical that a security software change is forthcoming, in order to allow Employer to allocate resources to implement the software change when it is released.

The initial testing for Employer’s configuration shall be done in an environment that is operationally similar to that of the meters, communication network and HES. Testing shall have the goal of confirming that the patch indeed corrects the published error and does not introduce any new errors.

The security patch shall be tested and installed on the HES within seven calendar days of its release by the software Supplier.

The implementation and testing of all security patches shall follow the established configuration management and change control processes. This includes the execution of test procedures where the change is deemed “significant”.

11.B.3 Obligation for Notification of Security Vulnerabilities

The Supplier, during all the Contract period, shall immediately inform Employer upon the discovery of an error in or a property of any software resident on the HES that makes the HES vulnerable to cyber-intrusion.

The Supplier shall diligently work to correct the error or modify the property to close the vulnerability, and shall make the correction available to Employer at no cost.

This obligation for notification and the closure of security-related vulnerabilities shall not expire upon the completion of warranty or other contractual obligations but shall remain in effect for the lifetime of the HES or until Employer informs the Supplier in writing that the obligation for notification has been waived.

11.B.4 Disposition of Sensitive Information

Any hardware, documentation, or other material replaced during maintenance shall be disposed in such a manner as to protect sensitive information.

- This includes maintenance actions performed on the HES, as well as the Supplier’s remote diagnostic system.