Material Specification

Version no.0 dated 27/03/2026.

Subject: GSSM011 (Colombia) – Smart Meter P2M

Application Areas
Perimeter: *Local*
Staff Function: -
Service Function: -
Business Line: *Enel Grids and Innovation*

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1. DOCUMENT AIMS AND APPLICATION AREA

This document describes the requirements for the purchase of the main components of the advanced metering infrastructure (AMI) or smart metering system, in accordance with countries' laws, normative and resolutions, which regulate the electrical energy measurement system.

The main components of AMI are monophase or polyphase energy smart meters with direct, semidirect or indirect connection, Data Concentrator Units and accessories described in this document.

This document applies to Enel Grids Colombia.

This policy applies to the Enel Group with the respect to its operations in Colombia, in accordance with applicable laws, regulations, collective agreements and governance standards, including the General Data Protection Law, which in any situation take precedence over the provisions contained in this document.

The General Data Protection Act, Law No. 1581 of 2012 (Colombia) regulates the processing of personal data. These Laws 1581/2012 for Colombia defines that treatment is any operation carried out with personal data, such as those related to collection, production, reception, classification, use, access, reproduction, transmission, distribution, processing, filing, storage, deletion, evaluation or control of information, modification, communication, transfer, dissemination or extraction, as well as that Personal Data is all information related to a natural person (physical person), which can make it identified or identifiable (such as: name, id number, phone number, address, mail address, name of family members, consumption profile, geolocation, Consumer Unit number, etc. , which in isolation, or associated with two or more, may directly or indirectly identify a data subject).

The Processing of Personal Data carried out during the activities described in this document must be duly mapped in the Enel Group personal data processing registry system, according to the Operational Instruction n. 3341 - Management of Personal Data Processing Registry and must take place in line with the rules of Personal Data Protection, SDG and Information Security of the Enel Group, established in the respective internal Policies and Procedures, listed in section 4 of this document.

This document shall be implemented and applied to the extent possible within the Enel Grids and Innovation Business Line and in compliance with any applicable laws, regulations and governance rules, including any stock exchange and unbundling-relevant provisions, which in any case prevail over the provisions contained in this document.

This document applies to Colombia.

1.1 Related documents to be implemented at country level

This document doesn't require implementation of further documents.

Anyway, each Enel Grids Company can issue, under the supervision of Enel Grids and Innovation Global Network Devices, a detailed document according to the provisions of the present document and in case of specific needs.

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2. DOCUMENT VERSION MANAGEMENT

Version	Date	Main changes description
00	27/03/2026	Firs issuing of “GSSM011 (Colombia) – Smart Meter P2M”

3. UNITS IN CHARGE OF THE DOCUMENT

Responsible for drawing up the document:

- Enel Grids and Innovation: Network Engineering and Development / Engineering Components and Devices / Network Devices unit.
- Enel Grids Colombia: Regulated Customer Operations / Balance Energy and Supply
- Enel Grids Colombia: Network Operation & Maintenance

Responsible for authorizing the document:

- Enel Grids and Innovation: Head of Network Devices unit.
- Enel Grids and Innovation: Operational Excellence and Processes Quality unit.

4. NORMATIVE AND REGULATORY FRAMEWORK

4.1 Applicable international standards

- Integrated Policy for Quality, Health and Safety, Environment, anti-Bribery and Information security.
- ISO 9001- Quality Management System – Requirements.
- ISO 14001 - Environmental Management System - Requirements with guidance for use.
- ISO 45001 - Occupational Health and Safety Management System - Requirements with guidance for use.
- ISO 37001 - Anti-bribery Management System - Requirements with guidance for use.
- ISO 27001 - Information Security Management System – Requirements.
- Policy n.344 - Application of Privacy Regulation within the scope of the Enel Group.
- Policy n.33 - Information Classification and Protection.
- Policy n.347 - Data Breach Management.
- Policy n.25 - Management of Logical Access to IT Systems.
- Policy n.37 - Enel Mobile Applications.
- Test Specification GRI-GRI-TST-E&C-0002 “GSSMC002: Qualification and reliability tests for meters production process validation”.
- GSCG002: “Technical Conformity Assessment”.
- IEC/EN 62052-11:2020 IEC 62052-11:2020 Electricity metering equipment - General requirements, tests and test conditions - Part 11: Metering equipment
- IEC/EN 62052-31:2015 Electricity metering equipment (AC) – General requirements, test and test conditions. Part 31: Product safety requirements and tests.
- EN IEC 62053-21:2021/A11:2021 Electricity metering equipment - Particular requirements - Part 21: Static meters for AC active energy (classes 0,5, 1 and 2). EN IEC 62053-23:2021/A11:2021 Electricity metering equipment - Particular requirements. Part 23: Static meters for reactive energy (classes 2 and 3).
- IEC 62058-11 “Electricity metering equipment (AC) - Acceptance inspection - Part 11: General acceptance inspection methods”
- IEC 62058-31 “Electricity metering equipment (AC) - Acceptance inspection - Part 31: Particular requirements for static meters for active energy (classes 0,2 S, 0,5 S, 1 and 2)”;
- EN 50065-1 “Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz Part 1: General requirements, frequency bands and electromagnetic disturbances”

- IEC/EN 62056-21 Data exchange for meter Reading, tariff and load control - Direct local data exchange.
- ENRE Note NO-2024-109520846-APN-ENRE#MEC
- IEC/EN 60529 Degrees of protection provided by enclosures (IP Code).
- IEC 62059-41 Reliability prediction test.
- IEC 62059-32-1 Electricity metering equipment - Dependability - Part 32-1: Durability - Testing of the stability of metrological characteristics by applying elevated temperature.
- IEC/EN 62054-21:2004/AMD1:2017 Electricity metering equipment (AC) – Tariff and load controlPart 21: Particular requirements for time switches.
- EN 50550 "Permanent Surge Protectors (POP)";
- IEC 62059-41 Reliability prediction test
- IEC 62059-32-1 Electricity metering equipment - Dependability - Part 32-1: Durability - Testing of the stability of metrological characteristics by applying elevated temperature.
- IEC/EN 62053-52 Electricity metering equipment (AC) – Particular requirements – Part 52: Symbols.
- IEC 62055
- Cyber Security Guideline no. 13

4.2 Applicable national standards

- CREG 101 001/2022
- CREG 038/2014
- NTC 6079
- SIC 40972/2025
- NTC 1340 (IEC 60038)
- NTC 4597 (IEC61358)
- NTC 4649 (IEC62053)
- NTC 5226 (IEC 62052-11)
- NTC 2147 (IEC 62053-22)
- NTC 6232 (IEC 62053-24)

Notes:

- The supplier must make available, for the Enel inspector, on the site of the inspection, all the above-mentioned Standards, in their latest revisions.
- The International System of Units (Metric System) must be used for all supplies to be carried out.

4.3 Group Pillar References:

- The Code of Ethics of Enel Group.
- The Enel Group Zero Corruption Tolerance Plan (ZTC).
- Human Rights Policy.
- Organization and Management Model as per Legislative Decree No. 231/2001.
- Enel Global Compliance Program (EGCP).
- Test Specification GRI-GRI-TST-E&C-0002 “GSSMC002: Qualification and reliability tests for meters production process validation”.
- Packing, barcodes and key writing station local requirements for smart meters.
- Cyber Security Guideline no. 12 to Concentrators
- Cyber Security Guideline no. 13 to Smart Meters

5. ORGANIZATIONAL PROCESS POSITION IN THE PROCESS TAXONOMY

Value Chain/Process Area: Engineering

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Macro Process: Devices and Components Development

Process: Standard Catalog Management

6. DEFINITIONS AND ACRONYMS

Acronyms and Key words	Description
Acceptable Quality Level (NQA)	Acceptable Quality Level
AMI	Advanced Metering Infrastructure
AMR	Automated Meter Reading
CT	Current transformers
DA	Distribution Automation
Personal Data	Personal Data is any information relating to an identified or identifiable natural person, such as name, identification number, location data, an online identifier, or to one or more of the characteristic elements of his/her physical, physiological, genetic, mental, economic, cultural or social identity (see also Special categories of personal data).
Distribution Line Carrier (DLC)	System technology used a frequency range of 9 to 500 kHz with data rate up to 576 kbit/s.
FAN	Field Area Network
GIDI	Independent Data and Information Manager
GPRS	General Package Service via Radio (3G)
GPS	Global positioning system.
GSM	Global Mobile Communications System (2G)
HES	Head-End System
HHU	Handheld tool for operation and maintenance
IEC	International Electrotechnical Commission
L1	Phase R
L2	Phase S
L3	Phase T
LED	Light-emitting diode
Legal Metrology Board (DIMEL)	Legal Metrology Board
Low Voltage Manager (LVM)	Low Voltage Manager
MDM	Meter Data Management System
Metrological Technical Regulation (RTM)	Metrological Technical Regulation
NAN	Neighboring Area Network
NT1	Voltage level 1 (<1.000 V)
OR	Network Operator
P2M	Point-to-multipoint communication between the management and operation software and the meter. Usually, indirectly through UCD data concentrators or gateways.
P2P	Point-to-point communication between the management and operation software and the meter. Typically, directly over a WAN.
Personal Data Holder	Natural person to whom the personal data subject to processing refer to. He / she understood as an identified or identifiable natural person.
PLC	Powerline Communication
POD	Point of delivery
Personal Data Processing	Any operation carried out with personal data, such as those relating to collection, production, reception, classification, use, access, reproduction, transmission, distribution, processing, filing, storage, elimination, evaluation or control of the information, modification, communication, transfer, dissemination or extraction.

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Acronyms and Key words	Description
RF	Radio Frequency Communication
RTC	Real Time Clock
SCR	Suspension, Cut-off and Reconnection
Sensitive Personal Data (including biometric and health data)	In the context of data protection, particular attention deserves the category of personal data concerning racial or ethnic origin, religious conviction, political opinion, membership of a trade union or organization of a religious, philosophical or political nature, to data concerning to health or sex life, genetic or biometric data, if linked to a natural person. These data are defined by the LGPD as Sensitive Personal Data. Genetic data: personal data concerning the genetic, inherited or acquired characteristics of a natural person which provide unambiguous information about the physiology or health of such natural person, and which result from the analysis of a biological sample of the natural person in question. Biometric data: personal data resulting from specific technical processing relating to the physical, physiological or behavioral characteristics of a natural person which allow or confirm the unique identification of that person, such as photo, video, facial images or fingerprint data. Health data: personal data relating to the physical or mental health of a natural person, including the provision of health services, which reveal information about the state of health of that person.
SGO	Management and Operation System
TCP/IP	Transmission Control Protocol/Internet Protocol
UCD	Data Concentrator Unit
UM	Unit of Measure or Smart Meter
UMTS	Universal Mobile Telecommunications System (3G)
WAN	Wide Area Network

Table 1. Definitions and acronyms

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7. MATERIAL TYPES AND ENEL-GRIDS CODES

Smart Meters										
Item	**N of phases**	**N of wires**	**Basic Nominal Current (A)**	**Maximum Current (A)**	**Nominal Voltage (V)**	**Operating Voltage (V)**	**Cut-off Relay (A)**	**Connection / Communication**	**Country**	**Code**
1	1	2	5	≥60	120	±10%	≥60 Monopolar	Direct/P2M PLC	CO	511054
2	2	3	5	≥60	120/208	±10%	≥60 Bipolar	Direct/P2M PLC	CO	511055
3	3	4	5	≥60	120/208	±10%	≥60 Tripolar	Direct/P2M PLC	CO	511056
4	1	2	5	≥100	120	±10%	≥100 Monopolar	Direct/P2M Hybrid (PLC+RF)	CO	511057
5	2	3	5	≥100	120/208	±10%	≥100 Bipolar	Direct/P2M Hybrid (PLC+RF)	CO	511058
6	3	4	5	≥100	120/208	±10%	≥100 Tripolar	Direct/P2M Hybrid (PLC+RF)	CO	511059
7	3	4	1	≥10	Multirange	±10%	N.A.	Semidirect/P2M Hybrid (PLC+RF)	CO	511060

Data Concentrator						
Item	**Description**	**Nominal Voltage (V)**	**Communication with the server**	**Communication with meters**	**Country**	**Code**
8	Data Concentrator Unit, access point between software and meters, information aggregation, meter management and control.	120/208 ±10%	Cellular 3G/4G	PLC & Hybrid (PLC+RF)	CO	511061

Table 2. Material codes and characteristics

8. SMART METERS SPECIFICATIONS

8.1 General requirements

The meter must have a design that incorporates, as much as possible, the improvements that modern technique suggests, even when not referred to in these specifications.

If multiple units of the same meter are provided in a supply, each meter must be the same and have the same design as the others, with all their corresponding parts identical and interchangeable.

The meter must have self-diagnostics routines reaching all its internal functional modules.

The meter must be delivered to the DSO with the energy registers zeroed, including the displayed values, except for meters that undergo final inspection sampling, verification or calibration posterior in accordance with local reference standard.

The meter's power supply must not be considered as consumption of the consumer unit (line-load).

All meter technical literature, operating manuals, catalogs and software must be delivered to the DSO in Spanish.

The metrological accuracy and functionality of the meter must be immune to magnets of at least 0.4 T. IEC 62052-11:2020 standard must be applied.

The meter must have a minimum useful life of 15 years with a failure rate of up to 1% p.a. The supplier must present evidence that proves this.

The meter must be certified in compliance to all applicable international standards and local regulations that allows its

infield installation in the country of destination.

The manufacturer must declare compliance with the requirements stipulated in the following standards:

- CREG Resolution 101001 of 2022
- SIC Resolution 40972 of 2025

8.2 Electrical requirements

The following meters must be compliant with the standards in the chapter of references (IEC 62052-11:2020).

- The Monophase (1F) Smart Meter must contain the following characteristics:

Item	N of phases	N of wires	Basic Nominal Current (A)	Maximum Current (A)	Nominal Voltage (V)	Operating Voltage (V)	Max Power Consumption (W)	Connection / Communication
1	1	2	5	≥60	120	±10%	~ ≤2 or an alternatively compliant to applicable international standard	Direct/ P2M PLC
4	1	2	5	≥60	120	±10%	~ ≤2 or an alternatively compliant to applicable international standard	Direct/ P2M Hybrid (PLC+RF)

Table 3 Electrical Requirements Monophase Smart Meter

- The two-phase (2F) Smart Meter must contain the following characteristics:

Item	N of phases	N of wires	Basic Nominal Current (A)	Maximum Current (A)	Nominal Voltage (V)	Operating Voltage (V)	Max Internal Consumption (W)	Connection / Communication
2	2	3	5	≥60	120/208	±10%	~ ≤4,5 or an alternatively compliant to applicable international standard	Direct/ P2M PLC
5	2	3	5	≥100	120/208	±10%	~ ≤4,5 or an alternatively compliant to applicable international standard	Direct/ P2M Hybrid (PLC+RF)

Table 4 Electrical Requirements Two-phase Smart Meter

- The three-phase (3F) Smart Meters with direct connection must contain the following characteristics:

Item	N of phases	N of wires	Basic Nominal Current (A)	Maximum Current (A)	Nominal Voltage (V)	Operating Voltage (V)	Max Internal Consumption (W)	Connection / Communication
3	3	4	5	≥60	120/208	±10%	~ ≤4,5 or an alternatively compliant to applicable international standard	Direct/ P2M PLC
6	3	4	5	≥100	120/208	±10%	~ ≤4,5 or an alternatively compliant to	Direct/ P2M Hybrid (PLC+RF)

							applicable international standard	

Table 5 Electrical Requirements Three-phase Direct Smart Meter

- The three-phase (3F) Smart Meters with semi-direct connection must contain the following characteristics:

Item	N of phases	N of wires	Basic Nominal Current (A)	Maximum Current (A)	Nominal Voltage (V)	Operating Voltage (V)	Max Internal Consumption (W)	Connection / Communication
7	3	4	1	≥10	Multirange (58/100… 277/480)	±10%	~ ≤4,5 or an alternatively compliant to applicable international standard	Semidirect/ P2M Hybrid (PLC+RF)

Table 6 Electrical Requirements Three-phase Semidirect Smart Meter

- The meters must come into operation as soon as it is energized, by any of the phases.
- The nominal frequency must be 60Hz ±2% (SIC 40972/2025) .
- The operating voltage must ±10% of the Nominal Voltage.
- The temperature operative range must be from -25 ºC to +70º C.
- The relative humidity without condensation must be ≤95%.
- The meter must be able to operate from sea level up to a height, at least 3000 meters above sea level.
- Meter Constant for active and reactive energy measurements must be at least 3.000 pulses/ (kwh / kvarh)

8.3 Integrated Cut-Off Device

The meter must have an internal relay to allow the power disconnection and reconnect function. The cut-off device must implement the following number of poles (only phase cut-off):

Item	N of phases	N of wires	N of poles	Nominal Voltage (V)	Operating Voltage (V)
1	1	2	1	120	±10%
2	2	3	2	120/208	±10%
3	3	4	3	120/208	±10%
4	1	2	1	120	±10%
5	2	3	2	120/208	±10%
6	3	4	3	120/208	±10%
7*	3	4	N.A.	N.A.	N.A.

* N.A.: Not applicable

Table 7 Integrated Cut-Off Device

The max current of the internal relay must be compatible with the maximum current of the meter.

Reconnecting function of the internal relay must be implemented in the following way:

- Automatic (depending on the functionality)
- On-site command triggered by authorized users.
- Remote command triggered from the customer premises.

The internal relay must not have any parts accessible from the outside.

For Colombia, the meter must have a cutoff module that allows continuous conduction and switching of loads up to

rated current for each phase.

The relay must operate in an ambient temperature range of -10 to 70°C and in a voltage range of 120/208 V ±20%.

The relay must guarantee a life cycle of at least 10.000 operations without the need for maintenance.

The relay must return to the same condition (open or closed) after irregular events (e.g. blackout).

The relay shall generate information about functionality success or functionality failure beyond the interface of communication.

The meters must be delivered with the relay in closed state or ready to close by pushing the button in front of the meter.

8.4 Environmental Specifications

The meter must have a type of approval certificate withstand the following climatic conditions:

- **Operative Temperature Range**: from -25°C to 70°C
- **Relative humidity**: ≤ 95%, non-condensing
- **Minimum heigh over sea level**: ≥ 3.000 m.a.s.l.
- **Minimum degree of protection**: (according to IEC 60529) IP 54 for metrology compartment, IP40 for the full meter and IP20 for terminal blocks output

8.5 Measurement Accuracy

Smart meters must have a certificate of product conformity issued by an entity accredited by the National Accreditation Body of Colombia (ONAC) and valid on the date of acquisition of the element.

The accuracy of energy meters will be also verified by ENEL Colombia after delivery made by supplier, in accordance with the delivery plan agreed between the supplier and the DSO.

Calibration must be performed in laboratories accredited by the National Accreditation Body of Colombia (ONAC) based on the requirements contained in the NTC-ISO-IEC 17025 standard or the equivalent international standard or the one that modifies, adds or replaces it. The meters will be calibrated in 4 quadrants, active and reactive energy, and they must be in accordance with Colombian regulations.

The product conformity certificates for each meter type must be submitted to the DSO, valid at the time of delivery of the meters, in accordance with the delivery plan agreed between the supplier and the DSO.

The calibration procedure for energy meters must be subject to the provisions of the Colombian Technical Standard NTC 4856 or an equivalent IEC technical standard.

The meters with direct connection must have an accuracy class equal to 1 or better for active energy measurement (for Colombia this requirement must be compliant to CREG 038 of 2014).

For Colombia, the meters to be connected by instrument transformers must have an accuracy class equal to 0.5S o better for active energy measurement in compliance to CREG038/2014.

The meters must be able to measure reactive energy with an accuracy class equal to 2 or better (for Colombia this requirement must be compliant to CREG 038 of 2014).

The meter must be able to provide and store in independent registers the following measurands:

- Active (imported and exported) energies per phase.
- Reactive (imported and exported) in the 4 quadrants energies per phase.
- Active and Reactive Power per phase.
- rms voltage and current values (phase and neutral currents with 1% accuracy).
- power factor and phases angle values.

- frequency.

8.6 Back up Battery

The battery must be designed to ensure the correct smart meter operation.

The battery must operate for the entire life of the meter.

The meter must be able to maintain internal clock time, settings, and recorded information during a power outage for at least 8,760 hours (365 calendar days).

The battery must be internal the meter or, if it is external, it must guarantee its functionality for the entire lifetime of the meter and it must be accompanied by the seal specified in 8.8.7 Seals.

8.7 Nonvolatile memory

The smart meters must store all the meters parameters, profiling data and energy registers into non-volatile memory.

For Colombia, the meter must be able to set the integration period to the following values: 5, 10, 15, 30 or 60 minutes. Integration period defines how often data must be saved in nonvolatile memory.

Units of measurement shall have the capability to record measurements with a reading interval of every 15 minutes, and to store data on energy, voltage, and current channels for a minimum of 60 consecutive days, in compliance to CREG 101001/2022 and SIC 40972/2025 (e.g. 15 channels with reading interval of every 15 minutes, for three phase meter: A+, A-, R+, R-, A net, R+L, R+C, R-L, R-C, Iavrg L1, Iavrg L2, Iavrg L3, Vavrg L1, Vavrg L2, Vavrg L3; for at least 60 days).

8.8 Physical specifications

The meter, intended for internal use, must conform to the degree of protection of IEC60529. IP 54 for metrology compartment, IP40 for the full meter and IP20 for terminal blocks output, to prevent any access (both intentional and unintentional) to inner components without visibly breaking covers (environmental specifications).

The meter must have an external insulation protection class II (double insulation) according to IEC62052-11.

The meter must be overvoltage 6.000V category III according to IEC 62052-31.

The base and the cover of the meters must have the following characteristics:

- polycarbonate suitable for recycling or polycarbonate with Fiber Glass (recycling symbol must be printed on bigger parts)
- color light resistant
- flame retardant
- heat and flame resistant (class V0 in accordance with UL94)

The transparent window (display) must be made with a plastic material that isn’t subject to degradation due to direct solar radiation. The transparency of the window must be guaranteed for the whole lifetime of the meter when installed indoors and within rated environmental conditions.

Metal parts of the meter subject to corrosion must be protected and must resist to abrasives substances and normal operating handling.

The assembly, base, terminal block, terminal cover and cover must be made of insulating and non-hygroscopic materials. Materials must also be able to withstand high temperatures without deforming during the meter's useful life.

The meters must have a compact design and can be mounted on a DIN rail **and/or** fixed to meter panels with clamping devices (suspension hangers) on the top and holes at the bottom so that, by means of screws, the assembly on the meter panel can be completed. The meter mounting system must be protected with seals against unauthorized removal by sealing the terminal block cover.

8.8.1. Cover

The meter must have a cover constructed and adjusted so that to ensure the perfect operation of the device in normal condition and in cases of non-permanent deformation.

The electromechanical parts of the meter must be assembled in such a way as to prevent any access to the internal electronics without making external damage evident. This means that the base and the cover must be anchored to each other through a process that makes them like a single body avoiding their disassembling. In addition, this process doesn't have to show residues from the joining (such as burrs or damages to the cover and/or base).

The meter cover must be attached to its base throughout its perimeter, so that it is possible to identify a possible opening of the lid.

The meter and other devices must have proper security in their casing to leave traces in case of an attempt to open the casing. If the meter is opened by any tool, due to thermal shock or mechanical shock, it should not be possible to reassemble the casing (base and/or cover) without leaving any visible marks of tampering (such as cracks, fractures, deformations, breaks, and holes).

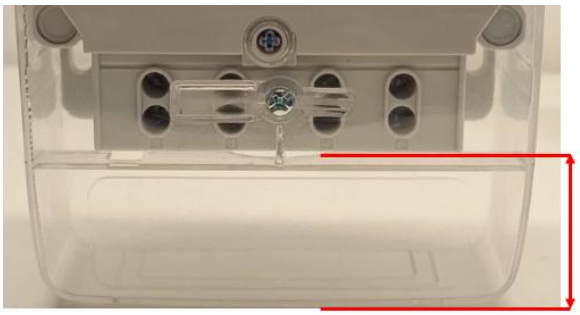
8.8.2. Terminal Block Cover

The meter must have the terminal block cover with the connection scheme drawings to the LV grid, engraved externally and indelibly.

The terminal block cover must allow the use of an external seal (for more details please refer to section 8.8.7 Seals).

The terminal block cover of the Meter must be made of polycarbonate in a color that allows good visualization of the meter terminals. Moreover, the terminal block cover material must comply with national applicable regulations.

The Terminal Block cover of the meter must be transparent and not flush with the terminal block. Approximately 3 cm from the terminal block of monophase meters and 4-5 cm form the terminal block of polyphase meters.



8.8.3. Terminals block

The meter must have a terminal block made of insulating material capable of not deforming after the meter has been submitted to the maximum current heating test.

The terminal material must comply with national technical standard (for example for Colombia: at 960°C ±15°C for 30s ±1s)

The meter must have the terminal block fixed to the base so that it can be removed only by breaking the seals of the meter cover and leaving on the cover the evidence of breakage.

The meter must not allow the terminals to move inside the meter, regardless of the fastening screws of the connection cables.

The terminals must be arranged in the line-load format according to national regulation, preferably an asymmetrical arrangement (Internal specification AE414).

Terminals Block must admit bimetallic cables (Cu – Al). Terminals Block must admit the following cables sections options for each meter type:

Smart Meters								
Item	N of phases	N of wires	Basic Nominal Current (A)	Maximum Current (A)	Nominal Voltage (V)	Operating Voltage (V)	Connection / Communication	Cables sections
1	1	2	5	≥60	120	±10%	Direct/P2M PLC	from 2 to 25 mm²
2	2	3	5	≥60	120/208	±10%	Direct/P2M PLC	from 2 to 35 mm²
3	3	4	5	≥60	120/208	±10%	Direct/P2M PLC	from 2 to 35 mm²
4	1	2	5	≥60	120	±10%	Direct/P2M Hybrid (PLC+RF)	from 2 to 25 mm²
5	2	3	5	≥100	120/208	±10%	Direct/P2M Hybrid (PLC+RF)	from 4 to 50 mm²
6	3	4	5	≥100	120/208	±10%	Direct/P2M Hybrid (PLC+RF)	from 4 to 50 mm²
7	3	4	1	≥10	Multirange	±10%	Semidirect/P2M Hybrid (PLC+RF)	from 2,5 to 16 mm²

Table 8 Cables sections

Terminal block must prevent accidental contact or short circuit of any live part.

All terminals must be clearly, unequivocally, and indelibly numbered on their front face, from left to right (meter in operating position) showing the function of the connected wires.

Terminals and screws set must be dimensioned to resist to a torque of 4 Nm to direct meters.

The terminal screws must have screws sized to withstand a torque of 20 N.m;

The screws set must be of the "cross-slotted" type for direct connect meters

The set of screws and terminals must be made of carbon steel with zinc-nickel. Other material is acceptable, if it is suitable for copper and/or aluminum cables.

Terminals and communication devices (if any) must be galvanically isolated from each other.

The meter must have a barrier for housing the terminal screws. In the event of complete loosening of the terminal screw, the barrier should not leave them exposed.

8.8.4. Visual Measurements Indication Device

The meter must have one or two optical test output for verification of energy consumption. If the device has only one optical test output, it must be selectable locally and remotely both active and reactive energy by a push - button or SW.

This output will emit light in the visible spectrum.

This output will allow the user a visual indication of the energy measurement.

8.8.5. Nameplate of the meter and information present on the device

Nameplate of the meter must comply with type approval report “and it must be agreed with the distribution company.

The nameplate must include information written with indelible ink, engraved on or under relief.

The information to be included on the device must be at least the following:

- Name of manufacturer
- Country of manufacturing
- Manufacturing year
- Logo or name of DSO
- Order number
- Serial number
- Model
- Rated Frequency, voltage and currents
- Minimum or rated current.
- Maximum current
- Number of elements
- Constant of the meter
- Class index for active energy measurement
- Class index for reactive energy measurement
- Temperature range
- Bar code (20 characters as minimum)
- Connection diagram to the network
- Certificate of conformity of the product

Serial number of the meter must be available also into the meter memory to be available for remote reading and visualization on the display (if required).

8.8.6. Maximum dimensions

The meter must meet the maximum dimensions:

Item	N of phases	N of wires	Basic Nominal Current (A)	Maximum Current (A)	Country	Code	Width (mm)	Height (mm) With terminal cover	Depth (mm)	Weight (Kg)
1	1	2	5	≥60	CO	511054	≤140	≤230	≤100	≤1
2	2	3	5	≥60	CO	511055	≤180	≤305	≤100	≤2
3	3	4	5	≥60	CO	511056	≤180	≤305	≤100	≤2
4	1	2	5	≥60	CO	511057	≤140	≤230	≤100	≤1
5	2	3	5	≥100	CO	511058	≤180	≤305	≤100	≤2
6	3	4	5	≥100	CO	511059	≤180	≤305	≤100	≤2
7	3	4	1	≥10	CO	511060	≤180	≤305	≤100	≤2

Table 9 Maximum dimensions

8.8.7. Seals

The seal must comply with the applicable national regulations and, in addition, the following requirements:

- Every meter must have independent devices for installing security seals on each removable cover or each reset button of the meter (e.g., the meter cover, the terminal block cover, communication module cover, demand reset device, if any).
- The terminal cover sealing holes must not be smaller than 2.0 mm.

According to SIC 40972/2025:

- The legally relevant software must secure the instrument against modifications and unauthorized uploads or

changes by swapping the memory device. A secure medium, such as a mechanical or electronic seal, is necessary to secure electricity meters that have an option to load software/parameters.

- Software protection includes sealing by mechanical, electronic, and/or cryptographic means, making any unauthorized intervention impossible or obvious.

8.9 Communication Interfaces requirements

Communications systems must comply at least with the provisions of numeral 6.4 of the Colombian Technical Standard NTC 6079 issued by ICONTEC or the one that modifies or replaces it (CREG 101001/2022).

Communication between the meters, the data concentrator and the HES/SGO system shall be carried out in such a way that 94% of a day's data (from 00:00 hours to 23:59 hours) are available as soon as possible on the day following the day of registration. These data are the set of information related to the provision of the domestic public electricity service. Included, in addition to the records of voltage, current, consumption or production of periodic active and reactive energy, are the service rates, those related to the absence/presence of voltage, number and duration of service interruptions and all those alarms or signals that indicate changes in the conditions of the advanced meter, as well as the programming of the advanced meter including the software/firmware of the meter operation and its possible update without affecting the metrological part and energy balances in the case of meters with prepaid function (CREG 101001/2022).

Communications must be bidirectional, allowing the exchange of information in two ways.

All equipment involved in advanced metering systems must have open protocols.

8.9.1. Interface with the Data Concentrator Unit

The smart meters must integrate a PLC modem or Hybrid (PLC+RF) modem that allows communication on the Low-Voltage Network with the Data Concentrator Unit.

Smart meters must support G3 Hybrid or G3 PLC standards and must be certified on all communication channels supported that guarantees interoperability between products from different manufacturers. Closed protocols, proprietary protocols, or standard protocols that include vendor-specific customizations will not be accepted (not described within the technical documentation) that will not guarantee in the future the integration of field devices with others smart meters of other suppliers.

Meters shall have the capability to record measurements with a reading interval of every 15 minutes, and to collect data from energy, voltage, and current channels.

The manufacturer shall provide detailed specifications for each technology and each communications standard to be provided, considering the following reference:

Specification	G3 PLC	G3 Hybrid (PLC+RF)
Data rate (kbps)	> 100	> 100
Typical application (UM/UCD)	> 300	≤ 300
Data collection rate (15-min intervals)	≥ 94%	≥ 94%
Multiplexing	Manufacturer Information	Manufacturer Information
RF Technology	N.A.	Compliant to the G3 standard.
Frequency band (MHz)	Manufacturer Information	Manufacturer Information (free use in Colombia)

Table 10 Communications specifications

- At least “suite 1” and the non-repudiation function of the related DLMS/COSEM standard in IEC 62056 must be complied with.
- The application layer protocols should be those defined in the IEC 62056 (Electricity Metering Data Exchange - The DLMS/COSEM Suite) standards.
- The data model defined in the IEC 62056 standards must be used. The use of these standards aims to

guarantee the interoperability between the Unit of Measurement (MU) and the Management and Operation System (SGO) implemented by Enel Colombia.

The smart meters must support push functionality of data towards the data concentrator of the same trademark and others that support the same communication protocol.

8.9.2. Optical Interface

The meter must be equipped with optical communication port in accordance with the IEC EN 62056-21.

The surface of the cover must help to properly position the optical probe head.

8.9.3. Other communications

The manufacturer must describe in detail other ports that are included separately in the equipment to do uplink and downlink.

8.10 Interoperability conditions

The smart meters must support remote communication at a logical communication level so that it can be efficiently controlled by Enel's automatic measurement management system (SGO).

The communication protocol that must be supported by the devices is DLMS/COSEM as defined by the standard IEC 62056, the following sections:

- IEC 62056-6-1, Electricity Metering Data Exchange. The DLMS/COSEM Suite. Part 6-1: Object Identification System (OBIS).
- IEC 62056-6-2, Electricity metering data exchange - The DLMS/COSEM suite - Part 6-2: COSEM interface classes.
- IEC 62056-5-3, Electricity metering data exchange - The DLMS/COSEM suite - Part 5-3: DLMS/COSEM application layer.

Communication profile that guarantees interoperability must be one of the following two standards. En TCA phase, the meter and its firmware must have its corresponding certificate issued by an entity authorized by DLMS UA.

- IDIS package 3 or
- the ACESM GCP developed by the DLMS UA.

Considering the communication technology offered, the manufacturer must demonstrate that have all the experience and documentation necessary to autonomously develop communication technology in devices without the need of any documentation support by Enel Grids. A declaration must be submitted by the supplier about this item.

In any case, the supplier must provide all the documentation necessary and the support to integrate the meters and concentrators through the HES systems defined by Enel.

The RF antenna of the meter must be internal of the device itself. The smart meters must guarantee also the installation of an external antenna by means of an SMA connector available on the device.

The meter must have a local communication interface (optical), which accepts parameter modification commands and data reading commands, with reserved protection keys (activable/deactivable), according to IEC 62056-21.

The communication protocol used for the local interface must be the same as indicated for communication via the remote system.

The supplier must provide an updated version of the software for **local reading and parametrization** of the meter.

Advanced meters or advanced metering systems shall have the last-gasp function (CREG 101001/2022). Therefore, if the data concentrator unit has the last-gasp function, this requirement is not mandatory for PLC meters. It is mandatory for Hybrid meters.

For TCA, the offered device must be integrated into Enel Colombia's management software. If the device and its firmware are not integrated into Enel Colombia's management and operation software, the supplier must assume the integration and development costs. Any new firmware version must not generate new integration and development costs; if they exist, the supplier must also assume these costs. Enel Colombia must authorize any new firmware version.

During the TCA integration tests can be performed to verify the possibility to integrate the Offred products with others supporting the same communication protocol by other manufacturers.

At the same time if the manufacturer has evidence regarding integration test already performed between its field devices with other ones, supporting the same communication protocols, it must be declared in the offer providing evidence (e.g. test reports).

8.10.1. Interoperability optional conditions

Optionally the technical documentation that will be shared by the supplier to guarantee the integration of its field devices into the Enel AMI ecosystem (based on G3 standard + DLMS) , following an agreement between the parties, can be also used by Enel for future tenders to guarantee the integration of devices of other suppliers into Enel remote system or even to manage the integrations between field devices of different trademarks.

8.11 Measurement Registers

The meter must measure active and reactive energy and display the consumption values on the display.

The meter must be bidirectional, and it must have separate registers for import and export active and reactive energies. It must have a “ratchet” type recorder for direct energy and a “ratchet” type recorder for reverse energy.

The meter must have separate registers for each quadrant (Q1, Q2, Q3, Q4) for active energy and for reactive energy.

The meter must indicate on the display which phases are energized.

The meter must indicate on the display the direction of energy flow (import or export and, for reactive energy also inductive or capacitive).

The meter shall have a register of each of the following measurements:

I. Active and Reactive Power per phase [kW; kVar].
II. Apparent Power [kVA].
III. Maximum demand (active and reactive).
IV. Instantaneous and average voltage per phase.
V. Instantaneous and average current per phase.
VI. Instantaneous current and total average.
VII. Service Tariff.
VIII. Absence of voltage (optional).
IX. Presence of Voltage.
X. Number of interruptions (optional).
XI. Duration of interruptions (optional).
XII. Firmware in operation.
XIII. Prepayment function Energy balance (optional)
XIV. First breath and Last gasp (Optional for PLC meters)

The meter can register several types of interruptions classified based on their duration: transient, short and long.The time threshold must be programmable and be set, by default, to the following values:

- Transients: ≤ 1second

- Short: > 1 second and ≤ 180 seconds
- Long: > 180 seconds

The information can be recorded as described below, by type of outage:

- Number of outages in the current period
- Number of outages in the run-up to
- Sum of the duration of outages in the current period
- Sum of the duration of outages in the previous period

Prepayment function Energy balance. The prepayment modality will be managed via Enel Systems (HES, MDM, WEB Portal, Customer Information Systems, etc.).

Connection, Disconnection and Service Limitation functions will be requested for the meters with direct connection.

8.12 Display Requirements

The meter must have an LCD display. The display must be active and show information whenever the meter is mains supplied.

The display can be composed by two different areas: it must show at least 8 alphanumeric characters in principal area, with a higher height than the rest of the icons and digits on the display.

The display must have an icons area (special symbols or operating indicators).

DLMS OBIS Code is compliant to the IEC 62056-64, and OBIS codes must be displayed on the screen/display.

Icon's area must show icons related to the following information:

- Quadrant in use (Q1, Q2, Q3, Q4);
- Meter serial number (could be scrolling). This parameter must remain visible on the display for 5 seconds.
- Measurement unit indication for active/reactive energy/power (kW, kWh, kvar, kvarh). These measurements must remain visible on the display for 5 seconds.
- Per phase voltage presence.
- Per phase current presence and direction (for example, "+" → import active energy, "-" → export active energy, "_" → current not present).
- Backup power status indicator.
- Alarm condition indicator.
- Communication signal level indicator.
- Tariff indicator.
- Cut-off element open

Display' device must be capable of registering, starting from zero, for a minimum time of 1150h, the energy corresponding to the maximum current at the highest rated voltage and unitary power factor.

Although this should be configurable, the display must show the energy quantity (kWh) with 5 (five) full digits.

The display life shall be equal to the life of the meter, and this shall be guaranteed in writing.

The display must be able to show all registers, with their respective identification OBIS code, at an interval time of 5s for each register.

OBIS (Object Identification System) codes, used in DLMS/COSEM, are defined and standardized within the IEC 62056-61 standard. Specifically, IEC 62056-6-1:2016 specifies the structure of OBIS and how data items in metering equipment are mapped to these codes.

The meter must allow also other configurations of display messages shown on the display for future implementation. It must guarantee the opportunity to display messages related to:

- Firmware information can be configured to be displayed in the display's alternate menus, not necessarily in

the display's main menu.
    - Firmware version running into the meter.
    - Checksum of the Firmware version running into the meter
    - N° of download of new Firmware performed on the meter
- Date of Last Billing period closure. The meter must allow future configuration of other messages on the several display menus. As a possibility to be considered in the future (e.g. Obligation to notify the customer of the dates of billing periods, etc.). The need for Enel to be able to set these messages into the future.
- Instantaneous Voltage
- Instantaneous Current
- Instantaneous Power
- Instantaneous Frequency

8.13 Firmware requirements

The meter firmware must be compliant with Local Regulations, and it must be developed with line and table structure, maintaining its principles of openness, interoperability, efficiency, robustness and communication security. This refers to the way the firmware code is organized.

- Line structure: The code is written in a structured manner, likely with clear separation of functions, modules, and comments.
- Table structure: Data and parameters within the firmware are organized in tables. This can be used for things like configuration settings, measurement parameters, or communication protocols.

The meter must support, among the other functionalities, firmware update through remote communication interfaces, complying with the characteristics of the meters offered, subject to prior approval by Enel and with guaranteed support from the supplier during the approval process.

The meter must allow its remote programming and local programming (through optical port) for different applications, such as simple tariffs (single tariff) set, hourly tariffs set, distributed generation, measuring quality indicators and others.

Remote and local programming must be done using the same protocol commands.

The supplier must offer unlimited support for activities related to firmware updating, including communicating any FW changes that may have an impact on the meters already installed.

Any new firmware version must not generate new integration and development costs; if they exist, these costs must be assumed by the supplier. Any new firmware version must be authorized by Enel Colombia.

8.13.1. Security

It must be provided with security keys to allow access only to authorized users and prevent the attempt of any unauthorized intervention, whether the access is local or remote.

Keys management must comply with requirements issued by Enel Group and in general to should guarantee at least the suite 1 level required by the DLMS protocol.

The device must guarantee the compliance to all security legal requirements applicable in Colombia for smart meters.

All the communications managed by the meter towards remote system must be secured and in line with Enel Policies.

The manufacturer must detail in the technical offer all the security measures implemented by the device itself.

8.13.2. Alarms

The meter must support at least the following sensors that must be monitored by the meter also to activate an alarm:

- Magnetic sensors for the detection of external magnetic fields.
- Sensor to detect removal of the terminal block cover (even with the meter off);
- Sensor to detect current flow with relay open. It is required to notify the Central System that a failure of the cut-off device has occurred.
- Sensor (or alternative solution) to detect status of the relay (open/closed).
- Sensor of the balance between the phase and neutral current.
- Sensor (or any other solution) for detecting the presence of voltage on the consumer side. It means that being the customer disconnected (i.e., meter main relay open) the meter must be able to detect the presence of voltage at the “client side”, between any phase and neutral. If the voltage read is greater than a certain threshold when the cut-off device is in open status an alarm must be activated.
- Sensor for detecting the absence of voltage.
- Communication module removal sensor.

The events and alarms must be configurable.

The meter must be able to detect and record (or activate an alarm) the following conditions:

- Fault and intervention alarms in the voltage and neutral circuits. Fault and intervention alarms in voltage and neutral circuits indicate potential issues within the electrical system. These alarms signal abnormal voltage levels or disruptions in the neutral conductor, which can be caused by various factors like short circuits, overloads, or damaged wiring.
- It is desirable (not mandatory) event to record Low Voltage Network overvoltage, undervoltage and voltage spikes in real time.
- The meter must generate alarms to identify the events occurring and must allow the alarms status to be extracted locally or remotely.
- Fault in a power supply backup element (necessary to keep the RTC and antitamper circuits running also when the meter is not powered).
- The meters must activate the Electromagnetic Pulse Display Alarm if subjected to any electromagnetic stimulus exceeding what is tested according to national standard.
- The meter could have last-gasp and first-breath functionalities (It´s mandatory for Hybrid meters. It’s optional for PLC meters, if Data Concentrator Unit has it).
- Voltage and storage interruption alarm
- Power limit violation alarm with history management in the meter's memory.
- Meter tampering alarms and records.

8.13.3. The Clock

The real time clock (RTC) must be inside the meter.

The clock must have a precision of < 0,5 sec. /day at a reference temperature of 23°C

The clock (RTC) precision without primary power for up to 36 hours < 1.5 sec. /day at reference temperature of 23°C.

It is permitted to drift in clock accuracy by temperature change of < 0.15 sec. /day/°C.

The meter must have remote clock synchronization.

8.14 Voltage outages

The meter must be able to record and store the last Voltage outages for each phase.

The meter must have a routine to automatically return to normal operation mode when power is restored.

The smart meter must be equipped with an internal backup supply to guarantee its correct performance.

8.15 Specific requirements

The meter must calculate consumption in at least 3 (three) tariffs (6 tariffs would be preferable to allow any future developments).

The meter must allow the configuration of at least 5(five) different time slots throughout the day.

The meter must allow the start and end of each tariff band to be programmed.

The meter must support seasonal configuration to allow the customer to have at least two tariff structures during the year (one for summer and one for winter).

The meter must be able to show the active tariff on the display.

The meter must allow the automatic management (activation and de-activation) of daylight-saving time (DST). This functionality must be configurable to be disabled or activated in other days of the year compared to the standard ones.

The meter must have sufficient memory to manage at least 20 public holidays (fixed or mobile) throughout its useful life or allow public holidays to be updated remotely.

8.15.1. Meter Identification

The meter's identification must be provided to the supplier by ENEL before starting the production process. The identification of the meter must be included in the marking of the meter. Marking of the meter must comply with local regulation and it must include also a QR code. The QR code information and the meter identification will be provided by ENEL before starting the production process.

Markings of the meter must be indelible and easily readable.

The QR-code, printed on the meter, must comply with the following format indications:

The type of coding to be used is "Alphanumeric".

The QR code pattern is "Model 2".

The QR-code version to be used is 5 (up to 122 alphanumeric characters can be encoded with error correction level "M"). The meter identification must have the space reserved for the DSO with a minimum of: 12x60mm and a maximum of 15x90mm, while the area for QR code must be at least 19,5x19,5 mm.

The identification must have a contrast that allows reading.

Marking of the meter must include also logo of the DSO, which must be indelibly engraved in monochromatic colors.

The asset number must be engraved in bas-relief and completed with indelible monochromatic ink (according to requirement 8.8.5) alternatively the asset number must be laser engraved or conventionally printed.

Regarding the detailed information to be included see paragraph "meter nameplate" (8.8.5)

8.15.2. Packaging label

Packaging must comply with requirements included in the documentation of Enel Colombia.

The packaging label must be approved by the DSO before starting the production process.

The packaging used for the materials for this acquisition must contain the following information:

- name or trademark of the manufacturer.
- Complete identification of the content.
- Type and quantity.

- Mass (gross and net) and dimensions of the envelope.
- Client name.
- Purchase order number.

9. DATA CONCENTRATORS SPECIFICATIONS

9.1 General requirements

The Data Concentrator Unit (DCU) mainly serves as an access point between the management and operation headend systems (WAN interface with SGO/HES), and advanced meters (NAN interface with UM) or other devices (FAN interface), ensuring bidirectional communication between them. In addition, it may have some or all the following functionalities:

- Aggregation of information from a set number of advanced meters (UMs) or other devices.
- Management and control of advanced meters (UM) or other devices, and their synchronization with the management and operation header system (SGO/HES)
- Execution of scheduled procedures (clock synchronization, AMR, SCR, sending of events and alarms, among others) with priority management.
- Metrology and/or analysis modules for various applications, such as measuring the energy balance of a low-voltage distribution network or monitoring the product quality (waveform and power) or condition of distribution transformers.
- Internal storage of a specified amount of data collected from advanced meters (UM) or other devices, with the ability to extract the information remotely and locally.
- Automatic self-discovery and self-registration due to the connection or disconnection of advanced meters (UM) or other devices.
- Dynamic routing of self-registered communications between the Data Concentrator Unit (DCU) and advanced meters (UM) by adding or removing communication nodes or links.
- Multipurpose and/or multi-service capacity for the exchange and support of information from other types of meters (water, gas, etc.) or sensors in its coverage area, under IEC 62056 standard protocols.
- Remote unlock and/or reboot to restore remote management.
- Detection of tampering or unauthorized access (anti-tampering).
- Notification of voltage reduction of each phase (-40% nominal voltage).
- Last gasp function by sending information to the system about the interruption or cut of the power supply.
- First breath function by sending information to the system about the restoration of the power supply.
- Data concentrators must support, among the others, operation mode as gateway. By this way the device can be able to collect information from smart meters of the same trademark, and even others trademarks, and push them towards the remote system.
- Must support push functionality in terms of data transmission towards the remote system.

The Data Concentrator Unit (UCD) must comply at least with the provisions of Article 16 of Resolution 101001 of 2022 issued by the CREG or those provisions that modify or replace it.

The Data Concentrator Unit must support, among others, the Last Breath and First Breath functionalities so that, when a power outage or restoration of the power supply of the power grid occurs, it can inform the DSO about the outage or restoration event before it is turned off or at the time of turning on, respectively.

9.2 Construction requirements

The design, manufacture and assembly of Data Concentrator Units (DCUs) must guarantee the appropriate flexibility that allows the evolution and replacement of embedded or non-embedded modules (modularity), for future maintenance or operational improvements.

The Data Concentrator Unit (DCU) can be composed mainly of the following elements or modules, preferably embedded:

- Data Concentrator (Base Device).
- Diagnostic and operating mechanisms (e.g. LEDs or display).
- Local access communication interfaces for local interrogation via operation and maintenance (HHU) tools.
- Optionally Metrology and/or analysis modules, in semi-direct connection (CT) at low voltage (NT1) for a current 1 (10) A.
- Communication module (modem) with the management and operation headend system (SGO/HES), which can be embedded or connected as an external device to the data concentrator.
- Communication modules (modems) with advanced meters (UM), **PLC and Hybrid meters specified in chapter 8**, or other devices, which can be embedded or connected as external devices to the data concentrator.
- Connectors for antennas (SMA) and antennas.
- Serial communication ports (ports, RJ45, RS 232, for data exchange).
- Ethernet ports (10/100/1000 M).
- Handling multiple Digital/Analog inputs and outputs
- Terminal blocks for connection and/or terminal block.
- Electronic circuit board protection housing.
- Covers with seal holders to show access to the connection terminals through seals placed at the time of installation.
- Integrated or interchangeable power supplies embedded or not, for connecting external modules.
- Protective box or cabinet for installation of the set of elements outdoors (if needed).
- Cables, accessories and brackets for complete installation.

Ideally, the complete set of elements or modules that make up a Data Concentrator Unit (DCU) should be as small as possible to offer greater versatility in installation. For the entire set of elements, the box or cabinet that contains them must have the following dimensions and characteristics:

Feature	Requirement
Max. height (mm)	≤ 619 mm
Max. width (mm)	≤ 583 mm
Max. depth (mm)	≤ 226 mm
Min. degree of protection	IP44 or higher
Weight (Kg)	≤ 1.3 Kg

The set of elements that make up the Data Concentrator Unit (DCU) will typically locate in the substations and/or in the distribution transformers. Therefore, it must be easy to assemble, and its installation must be able to be outdoor or indoor, on pole or in basement or underground type substations, local or surface type, or pedestal type.

The Data Concentrator Unit (UDC) must comply with electromagnetic compatibility standards.

9.3 Operating requirements

Data Concentrator Units (DCUs) must be designed and manufactured with new materials and/or components of the best quality, to ensure that they meet the requirements of continuous operation, as follows:

Feature	Requirement
Lifespan (years)	≥ 15 years old
Maximum annualized failure rate (AFR) (% per year)	≤ 0.3% per year

The communication interface between the Data Concentrator Unit (DCU) and advanced meters (UM) or other devices will depend on the medium and communications technology being applied. In this sense, it is necessary to maximize and inform the average communication distance between the Data Concentrator Unit (DCU) and the advanced meter (UM), without the need for intermediate devices (repeaters, etc.).

Feature	Requirement
Average communication distance between UCD and UM without signal repeaters (meters)	> 100 meters

Devices (network repeaters, others) may be implemented to increase this distance, in which case the average communication distance of these devices with the nearest terminal node must be specified.

Feature	Requirement
Average communication distance between intermediate device (network repeater, others) and nearest terminal node (meters)	> 100 meters

9.4 Electrical Requirements

The Data Concentrator Units (UDCs) must have the capacity to be connected according to the following electrical requirements:

Feature	Requirement
Operating voltage (Vac)	Withstand the following stresses: 120 / 208 Vac. 127 / 220 Vac. 230 / 400 Vac
Range of Variation of Tension (%)	+15%, -20%.
Nominal frequency Fn (Hz)	60 Hz
Frequency Variation Range (%)	± 5% Fn
Surge Protection	IEC Class IV
Backup source type	Battery, capacitors, others.
Run time with backup source (minutes)	> 1 min
Backup Source Lifespan (years)	≥ 15 years old
DC output to power optional external equipment (modems, etc.)	Output 12 Vdc – 12W Output 5 Vdc – 5 W Standard Connectors Ability to withstand inrush currents
Own consumption (W)	10 W (sin modem WAN)

To improve overall reliability and robustness, as well as safety requirements, the manufacturer is advised to install auxiliary devices or safety components for protection against overloads or other electrical stresses.

9.5 Quality requirements

The supplier must demonstrate that it has implemented and operated in its factory a Quality Assurance system with programs and procedures documented in manuals, complying with the following standards:

- ISO 9001.Quality Systems: A model of quality assurance in design, production, installation and service.
- In addition, ideally it should have the following environmental management certification:
- ISO 14001: Environmental Management Systems - Model of continuous improvement and pollution prevention, compliance with environmental regulations.

9.6 Environmental requirements

The devices that make up the Data Concentrator Unit (DCU) must be suitable to operate under the temperature and relative humidity conditions indicated in the IEC 62052 standard.

Feature	Requirement
Maximum altitude (m.a.s.l.)	2,850 m.a.s.l.
Min./max operating temperature (°C)	-25/+70 °C
Min/higher storage or transport temperature (°C)	-40/+85 °C
Operating Relative Humidity (%)	≤ 90% at 50°C (non-condensing)
Contamination Level (IEC 60815)	Medium (II)
Maximum solar ratio (wb/m2)	< 1,000 wb/m2

9.7 Firmware requirements

The main functional requirements of the Data Concentrator Unit (DCU) firmware are mentioned below:

- Indicators for local identification of the state and/or operating information.
- Ability to self-diagnose the main functions of the Unit.
- Time and date function with a maximum offset of 30 seconds with respect to the official time for Colombia.
- In storage or shutdown conditions, you must maintain the operation of the clock (RTC) for at least 3 years.
- In backup mode, without power supply from the main power supply, the UCD must maintain information on events or anti-fraud alarms.
- Remote programming or updating firmware with event logging.
- The Data Concentrator Unit (UCD) must also support Last Gasp and First Breath functionalities.

9.8 Communications and data transfer requirements.

Regarding communications, the Advanced Metering Infrastructure (AMI), and therefore the Data Concentrator Unit (UCD), must comply at least with the provisions of Article 18 of Resolution 101001 of 2022 issued by CREG or those provisions that modify or replace it.

The communication modules that make up the Data Concentrator Unit (DCU) must ensure two-way communication with other devices that support the same telecommunication technology and with the management and operation headend systems (OMS/HES).

The Data Concentrator Unit (DCU) shall essentially have the following communication interfaces:

- UCD – HES: Communication interface with the management and operation system (SGO/HES) with the capacity to operate over telecommunications networks with cellular (3G/4G/5G9), microwave, WiMAX, fiber optic technologies, etc.
- UCD – UM: Communication interface with advanced meters (UM), with the capacity to operate over wired and/or wireless telecommunications networks, **PLC and Hybrid (PLC+RF) is required**, in star, tree or mesh typologies, and preferably with the possibility of using an additional or backup communication channel to the main channel.
- UCD – Other: Communication interfaces with other devices and with operation and maintenance tools, with the ability to operate over wired or wireless telecommunications networks.

The communication modules used for the transfer of data through these interfaces shall have local indicators to identify the operating and functioning status of each module. In addition, the UCD-HES communication module must be supplied with the UCD and must have the possibility, automatic or on-demand, remote and/or local, to turn the module off and on.

Articles 10 and 42 of resolution 101001 of 2022 issued by the CREG, establish that the Network Operator (RO) must read the advanced meters "*in such a way that 94% of the data for a day (between 00:00 hours and 23:59 hours) are available for delivery to the GIDI from 8 a.m. on the day following the day of registration*". Therefore, communication solutions shall ensure adequate data transfer rates, including efficiency criteria, to ensure the availability of data in the systems (HES/SGO/MDM) as soon as possible.

To facilitate the exchange of data between the different components of the Advanced Metering Infrastructure (AMI), technologies with protocols defined by the following open standards must be used:

	Protocols Application layer	**Data model**
Local Access	IEC 62056	IEC 62056
Remote Access	IEC 62056	

The Data Concentrator Unit (UCD) must support cellular communication (e.g 4G) working in Colombia for the communication directly with the remote system implemented by the DSO. The communication module shall operate multifrequency band and at least B2 (1900), B4 (1700/2100 AWS 1), B5 (850), B7 (2600), B28a (700)).

The following detailed additional requirement must be considered applicable: the communication between the meter and the DSO must be by means of SIM card, simple or dual, M2M, that allows to configure manual APN (at least 3) and that supports the bands of 3G, 4G and 5G of Colombia.

9.9 Safety requirements

Regarding safety, the Advanced Metering Infrastructure (AMI), and therefore the Data Concentrator Unit (UCD), must comply at least with the provisions of Article 19 of Resolution 101001 of 2022 issued by CREG or those provisions that modify or replace it. It is worth noting that this resolution provided that "*at least suite one (1) and the non-repudiation function of the DLMS/COSEM standard related to the IEC 62056 standard or its equivalent must be complied with*."

10. FIELD OPERATION AND MAINTENANCE TOOLS

The supplier must provide the operation and maintenance tools, hardware and software, for local communication with concentrators and smart meters.

In addition to the infield devices, the supplier must provide probes allowing local communication with smart meters. These probes must be in line with all applicable regulations guaranteeing their compatibility with the infield devices offered and the tools available by the infield operators of the DSO (0,1% of the number of meters supplied).

The supplier is required to provide the technical specification for the hardware (probes, cables, etc.) and software (app, software, etc.).

The supplier must describe the main characteristics of the probes, providing main technical details, so that they can be evaluated and approved, if in line with Enel needs, by Enel itself.

11. TESTS

Suppliers must submit, compulsorily, upon product approval, or at any time, at the request of the DSO, under their responsibility, the following certificates and test reports:

- Certificates of “Model Approval” (initial and any modifications).
- RETIE certification (if applicable)
- Test reports referring to the type of approval process of all the regulations, for which the equipment is approved/mentioned in an approval decree.
- Minimum technical warranty starting from the installation date.
- All devices must include warranty certificates.
- Test Report including the lifetime of the meter according to the standard IEC 62059-31-1
- Functional and Communication Tests to ensure integration into the system used by the ENEL group for measurement and functionalities management.
- During the TCA integration tests can be performed to verify the possibility to integrate the Offred products with other ones supporting the same communication protocol by other manufacturers. If the manufacturer has

evidence regarding integration test already performed between its field devices with other ones, supporting the same communication protocols, it has to be shared the evidence (e.g test reports).

For all countries:

- All legal certificates need to allow installation in field of the devices according to national regulation.
- All tests must be carried out by laboratories accredited.
- During integration into the Enel system, the supplier must provide all necessary technical support.
- The TCA will be managed according to the specification GSCG002 Ver.4.

NOTE: The material must have implemented all technical requirements that were determined during the approval process (TCA). If the material changes, the supplier must inform Enel to prior assessment of the impact on the distribution network. Depending on the change, the supplier must carry out new tests so that the change in material does not compromise the minimum requirements required in this design technique. As provided for in GSCG002, any change in technology, the supplier must carry out a new TCA process with Enel.

12. FURTHER DOCUMENTATION TO SUPPORT THE TCA PROCESS

With regard to each Field Device, the manufacturer must deliver all the technical documentation listed below, necessary for the fully autonomous management of the functionalities of the products supplied as updated from time to time, in the event of any HW and/or SW modification developed by the manufacturer - through the Technical Conformity Assessment process - and with a guarantee of confidentiality by Enel for the management of such documents. The following is a list of documents that must be considered an integral part of the TCA process in addition to the documentation necessary for the tests and certifications indicated in the previous paragraphs:

1. Functional technical specifications of the devices describing HW and SW operation
2. Technical specification of the communication protocol describing the procedure and the structure of the messages exchanged between the filed devices.
3. Technical specification of the communication protocol describing the procedure and the structure of the messages exchanged between the filed devices and remote system allowing the integration of the device into Enel remote systems.
4. Software Default values specification
5. Identification parameters specification allowing their integration from a supply chain point of view;
6. Address communication programming.
7. Secret key management.
8. Firmware release notes.
9. Installation requirements Manual.
10. Software to support problem determination and diagnostic analysis.

TCA will be managed according to the specification GSCG002 Ver.3.

13. TRANSPORT, PACKAGING AND CONDITIONING

Provide packaging that aids the circular economy and the environment, i.e.:

- Use of reusable packaging.
- Packaging is made with recycled raw material.

The material must be packed to prevent the penetration of water and contain the identification.

14. SUPPLY

For the supply to DSO, a prototype must be homologated in advance.

15. WARRANTY

The equipment, as well as its components and accessories, must have a factory warranty for the minimum period of 5 years or as indicated in the acquisition processes, against any manufacturing defect counted from the date of delivery.

The equipment must have a failure rate of up to 1% per year throughout the warranty period and if this rate exceeds the limit of 1.00%, the supplier must automatically extend the guarantee from another 12 months, up to a limit of 7 years.

The smart meters and data concentrators must have a minimum useful life of 15 years.

The equipment must have local technical support to resolve problems, if necessary, at least for the warranty period.

The supplier must provide the necessary support for the installation and use of the equipment and integration of the product into the remote systems.