LOW AND MEDIUM VOLTAGE

Tender Specification
for electrical cloud computing system
The aim of this document is to provide outline specification of a cloud computing platform architecture able to satisfy supervision of electrical system and performance, analysis of relevant data and optimization of installation, control and implementation of energy management strategy.

The system must be scalable, shall be able to collect data from main electrical low- and medium-voltage equipment installed in main and sub-distribution switchboards, and shall establish cloud connection.

Web clients can access to dashboard and data on web, where is possible to configure the system and customize reports and alarms.
Electrical Standards

Components shall be compliant to latest versions of following standards and regulations:

- **IEC 60947-1** “Low-voltage switchgear and controlgear – Part 1: General rules”
- **IEC 60947-2** “Low-voltage switchgear and controlgear – Part 2: Circuit-breakers”
- **IEC 61131-3** “Programmable controllers – Part 3: Programming languages”
- **IEC 60870-5-104** “Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles”
- **IEC 61000-4** “Electromagnetic Compatibility testing and Measurement package”

**EC directives:**

- “Low voltage Equipment” No. 2006/95/EC
Environmental characteristics

For low voltage equipment the following environmental conditions shall be considered:

**Temperature:**
- Operating temperature: -25 °C ...+70 °C
- Storage temperature: -40 °C...+70 °C

**Environmental parameters:**
device shall comply with IEC60721-3-6 (class 6C3) and IEC60721-3-2 (class 3C2)

**Pollution degree:**
device shall be used in environments type PD3

**Vibrations:**
device shall comply with IEC60068-2-6 (1 mm displacement 1-13Hz, 13-100 Hz with acceleration = 0.7 g).

For medium voltage (indoor) equipment the following environmental conditions shall be considered:

**Temperature:**
- Operating temperature: -25 °C ...+55 °C
- Storage temperature: -30 °C...+70 °C

**Relative humidity:**
0…93% non-condensing
Functional characteristics

Supervision system shall be able to collect data from the field and, through Ethernet bus, store information in one system, accessible via Cloud. Data and parameters measured depend on electrical devices connected, in addition to monitoring of electrical magnitudes; system shall provide status and maintenance indicators, alarms and alerts.

Main device of supervision system architecture is a communication module with an integrated software that behave as concentrator and gateway, allowing management of parts of electrical system located in different areas directly from web application.

**Scalability**
It shall be possible to design different architecture sizes, with adoption of one single communication module or it shall be possible to integrate more communication modules to supervise one electrical installation, according to number of devices interconnected and functionalities required.

System shall have high degree of flexibility enabling the integration on electrical systems already installed with limited impact on existing architecture.

System scalability shall ensure integration of new devices without requiring re-programming or re-configuration of the connected system. It shall be possible to add web-services at any time without requiring re-programming or re-configuration of the connected system.

**Electrical Devices**
It shall be possible to connect supervision system to electrical devices provided with communication protocols supported (Modbus RS485 and Modbus TCP). It shall be possible to interconnect to cloud supervision system devices of type specified below:

- Air circuit breakers, also from multiple suppliers
- Moulded Case Circuit breaker, also from multiple suppliers
- Metering devices, also from multiple suppliers
- Metering and monitoring device system for miniature circuit breaker
- Fusegear
- Automatic transfer switch
- Digital Meters / sensors, also from multiple suppliers
- Analog Meters / sensors, also from multiple suppliers
- Arc flash protection system
- Low voltage relay used to upgrade brownfield
- Retrofitting low voltage air circuit breakers
- Medium voltage relay
- Medium voltage breaker and switchgear condition monitoring device with temperature and partial discharge sensors
- Interphase protection relay
- UPS
- Power Converters

**Communication**
Protection and metering devices shall be provided with standard communication protocols Modbus RS-485 or Modbus TCP.

Main communication module shall work as interface between electrical devices and cloud and shall be provided with Ethernet port. System shall provide automatic monitoring of communication, and alerts shall be notified in case of communication problems.
Data storage and notifications
Supervision system shall have a data logging interval of 30 seconds to ensure a fast reaction in case of warning or alerts and continuous measures for reliable efficiency analysis.

Supervision system shall be designed to monitor following data, without storage limitation capability. Consumption measures, depending on the device connected, might include:
- Currents
- Voltages
- Active Power
- Reactive Power
- Apparent Power
- Active Energy
- Reactive Energy
- Apparent Energy
- Power Factor
- Peak active Power

Quality data might include:
- THD
- Total reactive Power
- Voltage Unbalance
- Voltage Spike
- Voltage micro-interruption
- Voltage short Sage
- Voltage middle Sag
- Voltage long Sag
- Voltage short Swell
- Voltage Long Swell

Maintenance data might include:
- Contact wear
- Number of trips
- Total operations
- Manual operations
- Operations Timing (for medium voltage breakers)
- Environmental conditions (humidity, temperature, vibration)
- Temperature for joints (cable, busbar, breaker and other joints)
- Partial discharge presence indication, strength and pulse rate (for medium voltage switch-gears)

It shall be possible to monitor status of devices and alarms. It shall be possible for web user to set up to 300 different alerts, identifying alerts for specific devices or on all devices, in order to schedule maintenance and to check health of installation.

Alerts shall include:
- Phase and neutral currents
- Phase to phase and phase to neutral voltages
- Total active power
- Total reactive power
- Total apparent power
- Power factor
- Number of operations
- Contacts wear
- Trip coil disconnected
- Overtemperature
- Motor operator overtemperature
- Circuit breakers trip
- Any trip
- Any alarm
- Status Open/ close
- Connectivity Status

It shall be possible to set alarms and define type of notification through e-mail and/or eventually SMS for each user.

Analytics and reports
Supervision system shall be provided with web app with preconfigured widget to allow immediate overlook of plant consumption and analytics based on collection of data on selectable period of one day, one week, one month, one semester, one year or on custom period.

Widget should be designed to display single or multi-site information and shall include both power utility consumption and power generated on site. Web app shall allow the creation and customization of “digital” representation of asset, allowing importation of single line diagram or switchboards’ front view. It shall be possible to activate the graphics by connection with markers or tags, to easily access to device data.
Export of data and trends in excel shall be possible on-demand, via automatic report scheduling function or through dedicated API. It shall be possible to generate reports for all information managed or generate customize reports selecting specific measures and devices. Benchmark on multi-site level shall also be possible to compare plants and systems and identify best practices.

**Predictive maintenance**
Cloud and computing system shall include module for evaluation of low voltage and medium voltage power breaker’s condition, the algorithm shall be based on mechanical and electrical data as well as environmental conditions to define accurate performance trend and predictive maintenance plan.

Device’s condition is clearly identified by colour, green for healthy breaker, yellow, orange and red when performance decreases. For more accurate evaluation of low voltage breakers and switch disconnectors derived from air circuit breaker with external trip unit, reliability curve shall be available.

Last date of maintenance shall be visible, and algorithm shall propose next date for maintenance based on breaker’s trend. Reliability curve shall update automatically after maintenance operation.

For more accurate evaluation of medium voltage breakers and switchgears the algorithms shall provide the overall health indication of the equipment as well as main sub-components health status, so to drive maintenance activities only when and where required.

In case an event modify the reliability curve, the system shall send a notification.

**Commissioning and maintenance**
System shall allow final user or panel builder to execute the commissioning with the simple use of free software provided by manufacturer. Automatic recognition of devices shall be ensured so that there are no needs of programming and free software shall include wizard for commissioning directly from web.

Free software provided by manufacturer shall allow execution of system implementation without requiring system integrator.

**Interface**
System shall be supplied with pre-set graphic pages with dashboard for immediate evaluation and management of power consumption. It shall be possible to display dashboard on tablet or smartphone. It shall be possible to create up to ten different dashboards with up to 20 widgets perform economical and technical analysis.

**Security**
Encrypted communication channel and certification shall follow TSL protocol to ensure maximum safety level available. TSL protocol shall be provided embedded in the module for supervision and cloud connection.

**Level of users**
It shall be possible to define at least 4 different profiles for users. Only one of the users can be identified as owner. The owner shall sign up the EULA to start the data transmission and has the rights to renew licence of use. Only owner and administrator can send invitation to other users and have rights to change roles.

It shall be possible to define staff profile with the rights to access to asset and device view, alerts view, analytics view and control view. It shall be possible to assign guest profile for enabling users to access only to dash board view.
This part of outline specification describes the requirements for hardware to build up and perform functionalities in previous paragraph.

To satisfy all installation conditions, it shall be possible to achieve monitoring and controlling functions by using a module embedded in air circuit breaker or by adoption of external module.

Solution embedded in Circuit Breakers and Transfer switching
Module for supervision and cloud connection shall be provided as cartridge-type module to be mounted in terminal box of air circuit breaker, transfer switching device or low voltage relay for brownfield upgrade, without requiring additional space in electrical switchboard.

It shall be possible to mount the same module for supervision on external cartridge connected to moulded case circuit breaker.

Module for supervision and cloud connection shall be provided as internal module to be mounted in dedicated slot in the case of moulded case circuit breaker.

The module shall be connected to Ethernet switch via Ethernet cable.

Solution with external module
Module for supervision and cloud connection shall be provided as external module for DIN rail mounting.

The module shall be connected to Ethernet switch via Ethernet cable or via 3G/4G or Wireless technology.

License and firmware update
Transmission and access to data and analytics is set per license. License shall include automatic firmware upgrade and maintenance.

Connection
It shall be possible to connect to one embedded cloud module up to 18 devices through Modbus TCP communication protocol or 18 devices through Modbus RTU and at least 8 digital inputs for dry contact (on/off).

It shall be possible to connect to one external cloud module up to 22 devices through Modbus TCP communication protocol, 15 devices through Modbus RTU, 2 digital inputs for pulse metering and 2 analog input. System shall allow multi hub architecture to enable no limitation to number of devices monitored.

On-site system level communication
On-site, it shall be possible to connect the equipment to a local control system, such as Electrical Control System, Building Management System or Distributed Control System using a standard protocols, like: Modbus RTU/TCP, Profinet/Profinet, IEC61850.