

Tender Specification for cloud based electrical energy and asset management systems

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PART 1-GENERAL

1.1. Introduction

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 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 including reports and alarms.

1.2. Standards and directives

Components shall be compliant to the 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”

IEC61131-3 “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

“Electromagnetic compatibility Directive” (EMC) No.2004/108/EC

1.3. Other references

Below are the reference standards/guides related to overall energy management or industrial automation and control systems:

ISO 50001:2018 Energy Management System

IEC 60364-8-1 Low-voltage electrical installations - Part 8-1: Functional aspects - Energy efficiency

ISO/IEC 17021-1:2015 Conformity assessment -Requirements for bodies providing audit and certification of management systems

LEED (Leadership in Energy and Environmental Design) - Green Building rating system

BREEAM (Building Research Establishment Environmental Assessment Method)

ANSI/ASHRAE Standard (ANSI/ASHRAE 135).

Cyber security standards: IEC 62443-4-1:2018 “Security for industrial automation and control systems - Part 4-1: Secure product development lifecycle requirements

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PART 2-PRODUCT AND SYSTEM DETAILS

2.1. 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

2.2. Functional characteristics

This part indicates the Supervision system shall be able to collect data from the field and, through Modbus TCP or Modbus RTU protocols, 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/firmware that behave as concentrator and gateway, allowing management of parts of electrical system located in different areas directly from web application.

2.2.1 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, with a maximum of 400 devices. It shall be possible to add web-services at any time.

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2.3. General requirements

a) The system architecture shall be modular and fully integrated with the Remote Energy Monitoring system in cloud level. Each device shall be digitally addressable, and the meters communication network shall comply with Modbus RTU or Modbus TCP open protocols. Systems which are single vendor based and supporting only proprietary protocols shall not be acceptable.

b) The System shall include but not limited to the following components:

1. Edge and other type of Gateways.
2. Software subscriptions renewed annually or every multiple year.

2.4. Electrical devices

It shall be possible to connect supervision system to electrical devices provided with communication protocols supported (Modbus RTU 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
- Interphase protection (grid monitoring) relay
- Uninterrupted Power Supply (UPS)
- Power Converters
- Protection relay
- Energy storage system (ESS, BESS)
- Universal motor starter
- Soft starter
- Temperature monitoring relay
- I/O modules (digital/analogue/pulse)
- Connectivity interpreter for 3rd party devices

It shall be possible to set alarms for notifications through e-mail and/or SMS for each user.

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2.5. Communication

Protection and metering devices shall be provided with standard communication protocols Modbus RTU or Modbus TCP.

Main communication module shall work as interface between electrical devices and cloud and shall be provided with one of the following connections: Ethernet port, wi-fi or mobile connection.

2.6. Data storage and refresh time

Supervision system shall have a data logging interval of max 60 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:

2.6.1 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

2.6.2 Quality data, depending on the device connected, might include:

- THD
- Total reactive Power
- Voltage Unbalance
- Voltage Spike
- Voltage micro-interruption
- Voltage short Sag
- Voltage middle Sag
- Voltage long Sag
- Voltage short Swell
- Voltage long Swell

2.6.3 Maintenance data, depending on the device connected, might include:

- Contact wear

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- Number of trips
- Total operations
- Manual operations
- Environmental conditions (humidity, temperature, vibration)
- Temperature for joints (cable, busbar, breaker and other joints)

2.6.4 Status and alarms

It shall be possible to monitor status of devices and alarms. It shall be possible for web user to set up 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 for notifications through e-mail and/or SMS for each user.

2.6.5 Analytics and reports

The 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.

Widgets 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 configuration of “digital” representation of asset, allowing importation of any picture or drawing, schema or switchboards’ front view. It shall be possible to activate the graphics by connection with markers or tags, to easily access to device data.

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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 or generate customize reports selecting specific measures and devices. If required benchmark on multi-site level shall also be possible to compare plants and systems and identify best practices.

2.6.6 Predictive maintenance

Cloud and computing system shall include module for evaluation of low voltage air circuit 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 color, 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.

2.7. 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 personal computer, tablet or smartphone through a common web browser and without the need to install any software and/patches/drivers. It shall be possible to create different dashboards with various widgets perform economical and technical analysis.

The platform should be available 24/7.

It should be possible to insert any type of document in folder link in specific device, such document should be available for any user having and access to the platform.

2.8. Security

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

EDGE Gateway devices shall be provided with the following measures implemented to prove cyber security:

- Anti-tampering labels on the Gateway chassis
- External access physically removed:
 - SD Card slot disabled at boot code level
 - Serial console socket removed
 - JTAG socket removed
 - Serial access disabled at Firmware level
 - USB ports disabled at Firmware level
 - DIN railed, can be installed inside distribution panels

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- Optimized and hardened YOCTO Linux operating system
- Unused software is not only disabled, but also removed from the system to reduce attack surface
- Configuration and sensitive data are encrypted at rest
 - AES-256 based encryption
- Encryption keys are stored in a hardware Trusted Platform Module (TPM)
- Boot process and kernel images are signed and verified by the TPM
- Firmware images are signed and encrypted
- Firmware image is scanned regularly to discover new vulnerabilities
- Possibility to perform Firmware Over the Air updates
 - FOTA guarantee efficient and fast security patch delivery

2.9. 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 (end user license agreement) to start the data transmission and has the rights to renew license of use.

Only owner and administrator (manager) 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 dashboard view.

2.10. Mechanical characteristics

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 functions by using a module embedded in air circuit breaker or by adoption of external module.

2.10.1 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.

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2.10.2 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.

2.11. License and firmware update

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

2.12. Subscription editions

Different level of service packages (SaaS) shall be available to satisfy different customer needs.

2.12.1 Energy monitoring package

The project shall be fitted with following features:

- Visualize real time and historical trend data from your multi-utility devices
- Assess energy consumption for the different areas, including the one necessary for auditing processes
- Get quickly reports from your energy devices on consumption & generation with related cost allocation
- Forecast your energy profile
- Ensure benchmarking of data from different sites
- Visualize real time, trends, and historical energy data of assets.
- Monitor other parameters that can be read by Digital analog I/O (e.g., water, heat, gas...).
- Visualize the consumption of different groups to allocate the right consumption to different areas.
- Monitor critical power events.
- Create alerts, and reports.
- Including: Energy Management platform, different number of users, SMS Text Messages and Energy devices based on subscription, Multi-Dashboard, Multi-Language

2.12.2 Energy performance indicator package

The project shall be fitted with following features:

- Immediately recognize site performance by Energy Performance Indicators
- Collect time series data that may affect energy consumption in your plant
- Get rationales by APIs or by interpreter for 3rd party devices
- Integrate distributed energy resources together with energy multi-utility, electrical distribution and industrial equipment

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- Focus on the manufacturing industries.
- The collection of driving factors directly from production plant.
- Achieve continuous improvement in the company with EnPI definition.
- Supports ISO50001
- Track energy efficiency which helps to normalize energy consumption by any measurable, influencing factor.
- Including: Energy Management platform, different number of users, SMS Text Messages and Energy devices based on subscription, Multi-Dashboard, Multi-Language

2.12.3 Power quality package

The project shall be fitted with following features:

- Detect power quality anomalies from your medium and low voltage electrical distribution
- Identify power quality recurrency and impacts according to standardized KPIs
- Be advised on actions which can improve the power quality in your site
- Keep track on improvement action to measure your benefits
- Analyze problems manifested in voltage, current, or frequency deviation that results in failure or mis-operation of customer equipment.
- Set up alerts to Increase operational efficiency.
- Hierarchical view for the power quality.
- Including: Energy Management platform, different number of users, SMS Text Messages and Energy devices based on subscription, Multi-Dashboard, Multi-Language

2.12.4 Multi Site

The project shall be fitted with the possibility to compare the performance of up to several sites one to each other. It shall be possible to monitor the average consumption, the power usage index, the energy flows as per ISO 50001 and sustainability metrics such as CO2 emission.

2.12.5 Single Line Diagram

The project shall be fitted with the possibility to create a single line diagram representing the plant and allowing the user to monitor real time value such as current, voltage, power, power factor, the status of the devices in real time and localize alerts.

2.12.6 Power forecast

The project shall be fitted with the possibility to forecast the future energy consumption over a period of 24 hours in order to anticipate potential peaks of consumption.

The platform shall not require any data insertion in order to calculate the forecast and shall make the calculation based on historical data from two months period.

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PART 3-EXECUTION

3.1 Commissioning and maintenance

System shall allow final user or panel builder to execute the commissioning with the 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.

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