**SECTION 26 09 13**

**ELECTRICAL POWER MONITORING**

**PART 1 – GENERAL**

* 1. **SUMMARY**

1. This specification describes a multi-function power meter and associated current sensors designed for measuring, monitoring and reporting measurements within an electrical installation.
2. The technical benchmark is **SOCOMEC DIRIS A-200** or equal and approved.
   1. **SUBMITTALS**
3. Product data: Include rated capacities, weights, operating characteristics, furnished specialties and accessories.
4. Shop drawings: Dimensioned plans, elevations, sections, conductor entry provisions, installed features and devices and material lists for each switch specified.
5. Field quality control test reports.
6. Operation and maintenance data specified by the manufacturer.
7. Product certificates: Signed by manufacturer certifying that products comply with requirements mentioned.
   1. **RELATED STANDARDS**
8. **IEC 61557-12***: Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Part 12: Performance measuring and monitoring devices (PMD)*
9. **UL 61010-1 600V rated CAT III:** *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use*
10. **ANSI C12.20:** *Electricity Meters – 0.2 and 0.5 Accuracy Classes*
11. **FCC 47 CFR Part 15:2022 Subpart B :** *Radio Frequency Devices, unintentional radiators*
12. **IEC 62020-1***: RCM (Residual Current Monitoring) type A*
13. **PBI Eligible Meter***: (<2% accuracy), listed on California Energy Commission’s solar equipment list*
    1. **QUALITY ASSURANCE**
14. The components of the measuring system shall be of the same manufacturer.
15. Comply with requirements of latest revisions of applicable industry standards.

**PART 2 – PRODUCTS**

1. **MANUFACTURERS**
2. Subject to compliance with requirements, provide products by one of the following:
3. Multi-function power meter
4. SOCOMEC DIRIS A-200
5. …
6. **POWER METER REQUIREMENTS**
7. **GENERAL:**

The multi-function power meter should be a door mounted PMD\*, compliant with IEC standard 61557-12.

*\*PMD: Power Monitoring Device in accordance with IEC 61557-12 standard.*

1. The meter shall install in standard existing DIN 96mm cutouts.
2. The meter shall natively include RS485 + Dual Ethernet communication ports without requiring the addition of optional modules.
3. The meter shall support all service types (Single-Phase Two-Wire Line-to-Neutral; Single-Phase Two-Wire Line-to-Line; Single-Phase Three-Wire (Split-Phase); Three-Phase Three-Wire DELTA; Three-Phase Four-Wire WYE; and Three-Phase Four-Wire High-Leg DELTA).
4. The meter shall be universally compatible with any service voltage from 50-600 VAC L-N without adding any step down control transformer.
5. The meter shall support an external power supply from 115-600 VAC L-N without adding any step down control transformer.
6. The meter shall have mV current sensor inputs and therefore not require shorting blocks, allowing current sensors to be connected and disconnected under load.
7. The meter shall have 4 current sensor inputs. The 4th input can be used for neutral current measurement or ground leakage monitoring using dedicated zero-sequence CTs.
8. Current sensors shall come from the same manufacturer as the meter.
   1. Preferred current sensors are RJ12 based with color-coded RJ12 cables, enabling the meter to automatically detect the connected sensor type and rating without any configuration. This significantly reduces the risk for wiring and configuration errors, which can result in inconsistent readings.
   2. Other sensors are acceptable as long as they provide a safe low voltage mV output for disconnection under load without shorting blocks.
   3. The system accuracy (meter + associated current sensors) shall be class 0.5 or better, from 2-120% of CT rating as per IEC 61557-12 standard.
9. The meter shall offer monitoring capabilities for voltage, current, power, energy, and power quality, including features such as total and individual harmonics up to 63rd order, unbalance, and waveform capture.
10. The meter shall be compatible with a variety of current sensors for monitoring both new or existing installations, using solid sensors from 5A to 2000A, split-core sensors from 25A to 600A and flexible Rogowski coil sensors from 100A to 6000A.
11. If an installation or configuration error is detected during set-up, an alarm shall be automatically activated by the meter to notify the user of possible inconsistent readings.
12. The meter shall operate within an ambient temperature range of at least -25 ... +70°C / -13 ... +158°F.
13. **MEASUREMENTS**
    * + 1. The meter shall provide the following measurements:

* U12, U23, U31, V1, V2, V3, VN, F, I1, I2, I3, IN
* U system, V system, I system
* Bi-directional metering across 4 quadrants: ± kWh, ± kvarh (lagging and leading), kVAh
* ∑P, ∑Q, ∑S, ∑PF
* P, Q, S, PF per phase
* Demand and timestamped peak demand
* Predictive power (∑P, ∑Q, ∑S)
* Phi, cos Phi, tan Phi
* Voltage Ph/N unbalance
* Voltage Ph/Ph unbalance
* Current unbalance
* THD V, THD U, THD I
* Crest factor V, U, I
* Individual harmonics V, U & I (up to 63rd order)
* Voltage sags, surges, and interruptions (according to EN 50160)
* Overcurrent
  + - 1. The above measurements shall be available as:
* Instantaneous (user configurable from 200ms to 60s)
* Max instantaneous (timestamped)
* Min instantaneous (timestamped)
* Average (user configurable from 60s to 60min)
* Max average (timestamped)
* Min average (timestamped)
  + - 1. The meter shall also support a high-speed 1-cycle sampling rate (refreshed every 16.7ms @60Hz or 20ms @50Hz), accessible through dedicated Modbus registers, useful for demand response applications.

1. **POWER QUALITY MONITORING**
2. The meter shall monitor total harmonics distortion (THD U/V/I) as well as individual harmonics up to the 63rd order.
3. The meter shall provide a real-time view of current and voltage waveforms (scope mode).
4. The meter shall detect power quality events (surges, sags, interruptions and overcurrents) based on a ½ cycle updated RMS sampling rate.
5. The meter shall provide waveform capture for voltage and current upon power quality events, and shall be capable of capturing 160 samples per cycle or better.
6. The meter shall capture waveform both when the measurement exceeds the user-configurable threshold and when the measurement returns to within thresholds.
7. Pre- and post-event recording ratio shall be user configurable.
8. The meter shall be equipped with a power cap to ensure waveform capture is available even if the power supply to the meter is lost at the time of the event.
9. The meter shall record at least 50 sets of waveforms, each set containing up to 4 currents and 3 voltages.
10. Waveform captures shall be stored in a first-in, first-out circular buffer to ensure that data is always being recorded.
11. **TIME OF USE**
    * + 1. The meter shall internally record and log bi-directional Time of Use (ToU) energies on a perpetual calendar.
        2. The calendar shall support up to 4 different seasons, up to 4 different rates, holidays and special days.
        3. ToU energies shall be accessible for reading on the meter display, on the embedded webserver, and via communication protocols
12. **INPUTS/OUTPUTS**

The meter shall natively include at least 3 digital inputs and 1 digital output enabling the following:

1. Breaker/Switch status monitoring (OPEN/CLOSED position and Trip).
2. Pulse metering of 3rd-party utility meters (gas, water) with a pulse output.
3. Manual control of 3rd- party equipment through Modbus.
4. Change digital output NO/NC status upon alarm activation.
5. **DATA LOGGING**
   * + 1. The meter shall have up to 8GB memory for data logging and shall have a real-time clock for timestamping measurement data.
       2. The meter shall provide a 1-year recording of up to 12 average electrical values (configurable: U, F, I, P, Q, S, PF, THD, Iunb, Vunb, Uunb) with a 15-min reading interval.
       3. The meter shall provide a 1-year recording of demand profiles (+/- kW, +/- kvar, kVA) with a 15-min reading interval.
       4. The meter shall provide a 1-year recording of consumption curves (+/- kWh, +/- kvarh, kVAh) with a 15-min reading interval.
       5. The meter shall provide recording and timestamping of min/max electrical values.
       6. The meter shall log alarms and power quality events:

* Recording of up to 500 voltage power quality events and overcurrents
* Recording of up to 100 sets of waveform captures (4 currents and 3 voltages) upon power quality event, overcurrent and upon power supply loss
* Recording of up to 500 measurement alarms
* Recording of up to 500 system alarms

1. **ALARMS**

The meter shall provide timestamped alarms to notify operators of abnormal conditions.

* + - 1. The meter shall support up to 9 measurement alarms, each with low and high user configurable thresholds, for every measured parameter.
      2. The meter shall support up to 3 logical alarms upon status changes of its digital inputs.
      3. The meter shall support system alarms to notify the user of possible commissioning errors (CT on wrong phase, CT disconnected, bad CT rating, wrong phase rotation etc.)
      4. The meter shall support up to 6 protection alarms to alert in case of a protective device opening, breaker trip or faulty protective device.
      5. The meter shall provide email notifications to multiple recipients upon activation of any alarm and power quality event.

1. **ACCURACY**
   * + 1. The meter alone shall have certified class 0.1 or better accuracy for voltage and current, and class 0.2 or better for active power (kW) and active energy (kWh).
       2. The meter alone shall meet accuracy requirements of ANSI C12.20 (Class 0.2) and IEC 61557-12 (Class 0.2).
       3. The system (Meter + Current sensors) shall meet IEC 61557-12 accuracy class 0.5 for active power (kW) and active energy (kWh).
2. **DISPLAY**
   * + 1. The meter shall have a screen for local visualization of measurements.
       2. The meter shall have 10 direct keys to quickly navigate to relevant measurements and to perform diverse actions (meter configuration, meter reset etc.)
       3. The meter shall allow the user to customize up to 4 rotating screens, each screen capable of displaying up to 6 user-selected electrical parameters. This allows the meter to display electrical datasets that are most relevant to the operator.
       4. The user shall be able to customize the meter screen with their own company logo.
3. **COMMUNICATION**
   * + 1. The meter shall allow seamless integration with any external software through the following communication protocols:

* Modbus TCP over Ethernet
* Secure Modbus TCP over Ethernet
* Modbus RTU over RS485
* BACnet IP over Ethernet
  + - 1. Modbus maps, BACnet OIDs shall be openly accessible on the meter manufacturer’s website.
      2. The power meter shall have a dual Ethernet port acting as a switch, to be able to daisy chain multiple Ethernet based equipment without the need to add an IT switch inside the electrical panel.
      3. The meter shall provide 60 customizable Modbus registers for reading user relevant measurements in a single Modbus query.

1. **EMBEDDED SOFTWARE**
2. The meter shall have a free embedded Webserver to remotely visualize measurement data, without any subscription or license fees.
3. The webserver shall be reachable by multiple users from any web browser on a PC or tablet.
4. The webserver shall allow to configure communication settings and the cyber security policy.
5. The webserver shall offer multiple menus to display real-time and historical measurements in user-friendly graphical representations.
6. The webserver shall display a colored phasor diagram to help identify wiring or configuration errors (CT on wrong phase, wrong CT orientation etc.) which would result in inconsistent readings.
7. The webserver shall display on-going alarms and log of finished alarms
8. The webserver shall display waveform captures in case of voltage surges, sags, interruption and overcurrents.
9. The webserver shall display ToU consumption, allowing users to align and compare their energy usage with their utility meter.
10. The webserver shall allow a manual export of historical measurements over a chosen time period in a .CSV format.
11. **CYBER SECURITY**

The meter shall integrate the latest cyber-security features for confidentiality, integrity and availability of measurement data.

1. The meter shall support the following secure communication protocols by using TLS/SSL digital certificates:

* HTTPS for the web navigation. This encrypts all the scripts exchanged between the meter and the web browser to prevent a hacker from analyzing and attempting to decipher the codes.
* FTPS (data push) and SMTPS (email) for the transfer of data to a remote server.

1. The meter HMI and webserver shall implement a robust password policy to prevent unauthorized users from tampering with the settings.

* The webserver access shall be protected against unauthorized access by an advanced password (minimum 10 characters, one upper case, one lower case and a special character).
* The meter and webserver shall support password fail timeouts to eliminate brute force hacking.
* After 3 failed login attempts, the user shall be temporarily banned from accessing the webserver for a configurable duration, typically set to 1 hour by default.

1. The meter shall allow its authorized admin to implement and customize a security policy:

* Disable unneeded ports (USB, RS485)
* Disable unneeded protocols (BACnet)
* Disable Modbus READ and/or WRITE function
* Ban the use of unsecure protocols (HTTP, FTP)
* Choose maximum number of failed login attempts before ban and choose ban duration

1. The meter shall include a firewall to guard against denial-of-service (also called Flooding) attacks.
2. The meter shall support Whitelist rules to restrict access from only specific MAC addresses, ports and protocols.
3. **CONFIGURATION**
   * + 1. The configuration of the meter shall be accessible from its display, or using a free dedicated configuration software installed on a PC connected to the power meter via a USB connection or via the communication network (RS485/Ethernet).
       2. Upon initial power-up, the meter shall provide an intuitive step-by-step configuration WIZARD, facilitating the configuration of fundamental settings (such as Service Type, detected sensors, communication). This ensures that even personnel unfamiliar with the meter can easily configure basic settings, enabling the meter to report consistent readings without the necessity for additional tools or software.

**PART 3 – EXECUTION**

**3.01 INSTALLATION**

1. Preparation shall be in accordance with reviewed product data, final shop drawing and manufacturer’s recommendations.
2. Installation shall be in accordance with manufacturer’s instructions.
3. Identify components according to Division 26 section “Identification for Electrical Systems”.

**3.02 CONNECTION**

1. Wiring connection shall be in accordance with manufacturer’s instructions.
2. Wiring connection shall be according to Division 26 section “Low-Voltage Electrical Power Conductors and cables”.

**3.03 COMMISSIONING**

The manufacturer shall propose optional remote and on-site commissioning services for the power meter and visualization software.

**3.03 MAINTENANCE & TRAINING**

1. Operation and Maintenance Instruction: Personnel shall be formally trained by the manufacturer’s authorized representative as to the proper operation and maintenance of the power meter.
2. The power meter shall not require a new calibration for a period of 10 years minimum if the environment and installation conditions are conform to manufacturer’s instructions.

**3.04 TESTING**

1. The power meter shall be declared conform to the IEC and UL standards by a testing laboratory having the CBTL (Certification Body Testing Laboratory) qualification delivered by a National Certification Body under the IEC Electrotechnical Equipment (IECEE) certification body scheme and/or the NRTL (National Recognized Testing Laboratory) qualification.
2. After installing equipment, execute test reports in accordance with manufacturer’s instructions.

**END OF SECTION 26 09 13**