

## SECTION [26 27 13.16][16295]

### POWER QUALITY METERS

#### PowerLogic™ Meters and Related Devices by Schneider Electric

Schneider Electric Editor's Note:

This guide specification is written in accordance with the Construction Specifications Institute (CSI) Master Format. This section must be carefully reviewed and edited by the architect or the engineer to meet the requirements of the project. Coordinate this section with other specification sections within the Contract Documents and Drawings.

To properly use / edit this document, show formatting and hidden text by selecting ¶ on the menu or by typing (Ctrl+\*) simultaneously. Except for these introductory and closing paragraphs, green hidden text will not print. Text in red is optional. Red text in [brackets] denotes multiple options where one or more should be chosen. All red text should be edited and changed to black for final project conformation. In addition, these introductory paragraphs should be deleted or changed to hidden text.

**This specification may be used in whole or in part. It is intended that this document specify subcomponent products to be referenced by other specification sections or drawings for the furnishing of completed assemblies or systems. The Part 2 – Product subsections may also be copied into other specification sections in lieu of including this specification section in the Contract Documents.**

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, configuration and installation for power quality meters as required for the complete performance of the work, as shown on the drawings, as specified herein, and as specified elsewhere for the assemblies or systems comprised of the components specified herein.
- B. Related Sections: Related sections include, but shall not be limited to, the following:
  - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  - 2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
  - 3. Refer to specification Section 26 09 13 Electrical Power Management System for additional requirements.
- C. This specification includes requirements for the following equipment that may be referenced elsewhere within the Contract Documents.
  - 1. Power Quality Meters
  - 2. Utility Revenue Power Quality Meters
  - 3. Advanced Power Quality Meters
  - 4. Metering Cabinets

##### 1.2 REFERENCES

- A. General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
  - 1. American National Standards Institute (ANSI)
    - a. ANSI C12.20, "Electricity Meters - 0.2 and 0.5 Accuracy Classes."

- b. ANSI C12.18, "Protocol Specification for ANSI Type 2 Optical Port."
- 2. Canadian Standards Association (CSA)
  - a. CAN/CSA-C22.2 No. 61010-1 "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements"
  - b. C22.1, "Canadian Electrical Code, Part I" (CEC)
- 3. International Electrotechnical Commission (IEC)
  - a. IEC 62053-22 Class 0.5, "Electricity metering equipment (a.c.) - Particular requirements - Part 21: Static meters for active energy (classes 0.2 and 0.5) Edition 1.1 2016-11"
- 4. European Engineering Standards (CSN EN)
  - a. EN 61000-6-2, "Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments"
  - b. EN 61000-6-3 Class B, "Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - "Emission standard for residential, commercial and light-industrial environments"
  - c. EN 61000-6-4 Class A, "Electromagnetic compatibility (EMC) - Part 6: Generic Standards - Emission standard for industrial environments"
  - d. EN 61010-1, "Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements",
  - e. EN 61326-1 Class A, Electrical equipment for measurement, control and laboratory use EMC requirements Part 1: General requirements
  - f. EN 61326-1 Class B, Electrical equipment for measurement, control and laboratory use EMC requirements Part 1: General requirements, (Residential and light industrial)
- 5. International Organization for Standardization (ISO)
  - a. ISO 9001, "Quality Management Systems - Requirements"
  - b. ISO 14001, "Environmental Management Systems - Requirements with Guidance for Use"
  - c. ISO 14062, "Environmental Management - Integrating Environmental Aspects into Product Design and Development"
  - d. ISO 50001:2011 "Energy management systems"
- 6. National Fire Protection Agency (NFPA)
  - a. NFPA 70, "National Electrical Code® (NEC)"
- 7. Underwriters Laboratories, Inc. (UL)
  - a. UL 61010, "Electrical Equipment for Measurement, Control, and Laboratory Use."
  - b. UL 61010-1, "Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements."
  - c. UL 508, "Standard for Industrial Control Equipment"
  - d. UL508A, "Standard for Industrial Control Panels"
- 8. USA Federal Communications Commission (FCC)
  - a. FCC 47 CFR Part 15 Class A, "Radio Frequency Devices"
  - b. FCC 47 CFR Part 15 Class B, "Radio Frequency Devices"

### 1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

## 1.4 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section [01 33 00][01300] Submittals and Section [26 00 10][16010] Electrical Requirements, in addition to those specified herein.
1. Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.
  2. Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.
1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
  2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.
- B. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Process controllers, assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.
- C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

## 1.7 WARRANTY

- A. General: Refer to [Section 01 77 00 - Closeout Procedures] [Section 01770 - Closeout Procedures].
- B. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

## 1.8 SPECIAL TOOLS AND SPARE PARTS **[NOT USED]**

- A. The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:
  - 1. Contact information for the closest parts stocking location to the Owner.
  - 2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
  - 3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.
- B. Spare parts shall be provided for each type and size of unit furnished. At a minimum, the following shall be provided:
  - 1. Provide the minimum spare parts recommended by the manufacturer.
  - 2. **Provide [1] set of each type of power and control fuse installed within equipment**
- C. Any manufacturer specific special tool, not normally found in an electrician's toolbox, required to remove and install recommended or furnished spare parts shall be furnished. At a minimum the following shall be provided:
  - 1. If available from manufacture, provide PC-based configuration software tool and a minimum of **[one]** communication interface cable for each type of cable required to connect a PC-based computer to the devices specified herein for configuration and programming.
  - 2. Electronic configuration files, in a media format acceptable by the Owner (e.g. CD, USB stick, etc.), updated to an as-installed and commissioned state.
- D. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Products specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements.
- B. **Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:**
  - 1. **Square D PowerLogic by Schneider Electric**
  - 2. **[2<sup>nd</sup> manufacturer]**
  - 3. **[3<sup>rd</sup> manufacturer]**

### 2.2 POWER QUALITY METERS **[NOT USED]**

- A. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: **PowerLogic PM8000 by Schneider Electric, [2<sup>nd</sup> manufacturer] or [3<sup>rd</sup> manufacturer].**

- B. The metering device used to monitor the medium and low voltage mains as well as critical feeders for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:
1. High-visibility color graphical display.
  2. Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; Four metered 5 A nominal current inputs for 3 phase measurement plus neutral.
  3. Supported monitoring parameters—full range of 3-phase voltage, current, power, and energy measurements, total harmonic distortion (THD), individual current and voltage harmonics readings, waveform capture, voltage and current disturbances (dip/swell) detection, ability to determine the location of a disturbance (upstream or downstream).
  4. COMTRADE—up to 255 COMTRADE disturbance capture files available directly from meter via FTP and providing client notification of new captures through IEC 61850 (RDRE logical node).
  5. Power Quality compliance—without using separate software, determine statistical indicators of power quality that include but are not limited to voltage dips and swells, harmonics, and frequency in accordance with EN 50160 power quality standard and provide an indication of pass/fail in a web interface; Third party laboratory tested to the power quality standard IEC 61000-4-30 Class 'S'.
  6. User customization—capable of deriving values for any combination of measured or calculated parameters using arithmetic, trigonometric, and logic functions through graphical, flexible object oriented, programmable modules. Modules can be linked together in an arbitrary manner to create functionality such as totalization, efficiency measurements, control functions, load shedding, demand response, power factor correction, and compliance monitoring.
  7. Communications capability—multi-port Ethernet and serial communications with at least two Ethernet ports and one RS485 serial port. Functionality through Ethernet connectivity includes e-mail on alarm, e-mail interval energy data, on-board web server, SNMP network management, NTP time synchronization, Ethernet-to-serial RS-485 gateway, Modbus, DNP3, and IEC 61850.
  8. On-board logging: non-volatile time stamped on-board logging of input/output (I/O) conditions, minimum and maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand; custom alarming with time stamping in which the meter has the capability of learning set-point limits based on the system behavior; trigger alarms on at least 50 definable power or I/O conditions; use of Boolean logic to combine alarms.
  9. Input/outputs—provide at least three 3 digital inputs and 1 digital output for equipment status/position monitoring and equipment control or interfacing with millisecond timestamp. The meter shall accept up to four field installable I/O modules. Provide additional modules as required for application. Each digital I/O module shall provide 6 digital status/counter inputs and 2 Form C relay outputs rated at 250 V, 8 A. Each analog I/O module shall provide 4 inputs configurable to 4-20 mA or 0-30V ranges and 2 outputs configurable to 4-20 mA or 0-10V ranges..
  10. Disturbance direction – provide an indication of the location of each power system event as “up stream” or “down Stream” along with the level of confidence of the location.

### 2.3 UTILITY REVENUE POWER QUALITY METERS [NOT USED]

- A. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: PowerLogic ION8650 by Schneider Electric, [2<sup>nd</sup> manufacturer] or [3<sup>rd</sup> manufacturer].
- B. The revenue grade metering device used to monitor incoming utility medium voltage mains for grid revenue, substation automation, network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:

1. Form factor—ANSI socket 9S, 29S, 35S and 36S; user-selectable 9S, 29S, and 36S; FT-21 switchboard/draw-out style
2. Voltage and current inputs—3 phase inputs; Direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; 5 A nominal current inputs; equipped with two spring-loaded socket grounding tabs to ensure reliable electrical contact; mechanical bonding ground that may be optionally connected.
3. Supported measured and calculated metering parameters—four-quadrant metering, full range of three-phase voltage, current, power and energy measurements, percentage unbalance, power factor (true and displacement per phase and three-phase) demand (minimum/maximum, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), individual current, and voltage harmonics readings.
4. High accuracy standards—meet in a single device over the Class 2/10/20 current classes in a single device (over all environmental conditions and influence factors outlined in the standard and its referenced standards).
  - a. Less than half the measurement error of ANSI C12.20 class 0.2 accuracy over the Class 2/10/20 current classes.
  - b. Less than half the measurement error of IEC62053-22 class 0,2S accuracy from 0.010A-20A in a single device.
  - c. Less than 20 times the measurement error of IEC62053-23 class 2 accuracy from 0.010A-20A in a single device.
  - d. Support up to 8 points of magnitude and phase correction for each voltage and current measurement input.
  - e. Overvoltage/overcurrent protection—capable of meeting all accuracy specifications after withstanding 500A for 1 second or 2500 VAC RMS for 1 minute (with internal protection disabled).
5. High-visibility display with the following characteristics:
  - a. User programmable to display up to 4 quantities per screen.
  - b. Capable of displaying graphical metering data such as phasor diagrams, watt-hour disk simulator, spectral components etc.
  - c. Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.
6. Input/outputs—provide at least 4 digital inputs and 4 digital output for equipment status/position monitoring and equipment control or interfacing (e.g. Pulse output relay operation for kWh/kVARh total/imported/exported). Provide at least 4 analog 4-20 mA inputs.
7. Communications Capability.
  - a. Ethernet, RS485/232 serial, ANSI 12.18 compliant optical port.
  - b. Protocol support: DNP3.0(Ethernet/serial); Modbus slave/mastering (Ethernet/serial); SMTP/SNTP(Ethernet); MV90(Ethernet/serial); XML(TCP); IEC61850(TCP).
  - c. IRIG-B port to allow GPS time synchronization to +/-1ms accuracy from GPS source.
  - d. Automatically e-mail alarm notifications, scheduled system status updates and data logs on an event-driven or scheduled basis.
8. On-board logging.
  - a. Non-volatile time stamps with on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand.
  - b. Ability to record any parameter in the meter and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity).

- c. Continuous recording of intervals from 100 years down to ½ cycle.
  - d. Number of records (depth) and overflow conditions (stop-when-full or circular) shall be programmable.
9. On-board web server that can be used for:
- a. Access to real-time values and basic power quality data through a web browser.
  - b. Basic meter configuration.
10. Alarming capabilities:
- a. Set-point driven alarming capability.
  - b. Generate an email notification upon an alarm condition.
  - c. Millisecond resolution timestamp on alarm entries
  - d. Support consecutive high-speed alarm conditions for alarms and waveform recording, triggering on a cycle-by-cycle basis with no “dead” time between events (i.e., no need for a re-arming delay time between events).
  - e. Operate relays or initiate data logging captures on alarm conditions.
  - f. Control any number of digital output relays in an AND or an OR configuration using pulse mode or latch mode operation for control and alarm purposes.
  - g. Combine any logical combination of any number of available set-point conditions to control an internal or external function or event.
11. Time-stamped event log (1 ms resolution) with the following characteristics:
- a. Support at least 500 events, programmable up to a maximum of 20000 events.
  - b. For each event, record date and time, cause and effect, and priority.
  - c. Record all events relating to set-point activity, relay operation, and self-diagnostics.
  - d. Capable of synchronizing time stamps between devices on the same serial communications network, to within 100 mss.
  - e. Minimum event recording response time is ½ cycle (8.3ms 60Hz, 10ms 50Hz) for high-speed events and 1 second for other events.
  - f. Programmable set-point events.
12. Power quality analysis and compliance monitoring.
- a. Without separate software, shall have the following capabilities:
    - 1) Display statistical indicators of power quality on the front display.
    - 2) Compare power quality parameters (present, predicted, average, or calculated values) with an absolute or relative set point. When set-point is exceeded, alert via e-mail or pager, or enable control via a local interface to PQ mitigation equipment or control systems through relays and analog or digital outputs.
    - 3) Support EN50160 reporting for compliance monitoring.
  - b. Third party Laboratory tested to the power quality standards IEC 61000-4-30 Class 'A' 2nd edition, IEC 61000-4-15, and Flicker.
  - c. Low pass anti-aliasing signal filters to meet the requirements of IEC 61000-4-7:2002.
13. Fault recording and waveform capture.
- a. Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.
  - b. 1024 samples per cycle waveform recording, minimum 17/20 µs transient capture (60/50 Hz).

- c. Configurable to provide COMTRADE waveforms for all captures.
14. Disturbance detection.
- a. High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.
  - b. Detect disturbances less than one cycle in duration.
  - c. Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Capture analysis results in the event log, along with a timestamp and confidence level indicating level of certainty.
15. Programmability.
- a. Capable of deriving values for any combination of measured or calculated parameter using arithmetic, trigonometric, logic, thermocouple linearization, and temperature conversion functions,
  - b. Capable (through a graphical flexible programming language) of creating programmable modules with metered and input data through arithmetic and logic operations (such as minimum, maximum, set point, digital input, digital output, etc.) that can be arbitrarily linked together to create application functionality.
  - c. System Integration—capable of integrating with custom reporting, spreadsheet, database and other applications with XML compatible data.

## 2.4 ADVANCED POWER QUALITY METER **[NOT USED]**

- A. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: PowerLogic ION9200 by Schneider Electric, **[2<sup>nd</sup> manufacturer] or [3<sup>rd</sup> manufacturer]**.
- B. The metering device used to monitor medium and low voltage mains as well as critical feeders for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have, at minimum, the following capabilities:
  1. The voltage inputs of the meter shall provide a minimum of 4 phases, neutral and ground inputs. The meter shall support direct connection of low voltage circuits up to 600V (UL) or 690V (IEC) without need for voltage (potential) transformers. The meter shall support connection of medium and high voltage circuits through voltage (potential) transformers, and provide user definable primary and secondary transformer ratios.
  2. The current inputs of the meter shall provide a minimum of 5 inputs and support nominal input currents of both 5A and 1A.
  3. The meter shall support measured and calculated metering parameters including four-quadrant metering, full range of 3-phase voltage, current, power and energy measurements, % unbalance, power factor (true & displacement – per phase and three-phase) demand (min/max, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), individual current and voltage harmonics readings.
  4. The meter shall meet stringent IEC and ANSI measurement accuracy standards including ANSI C12.20 accuracy class 0.1, current class 2, 10 and 20, and IEC 62053-22 Class 0.1S (standard pending) and be fully compliant with IEC 61557-12 PMD.
  5. The meter shall have a high-visibility color graphical display that is user programmable to display up to 20 parameters per screen. The meter shall be capable of displaying graphical metering data including at minimum spectral components, phasor diagrams, and trending charts. The meter shall be capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format. The meter shall be provided with a **[96x96 mm (3.8") graphical color display with push-button control] [197x175 mm (7.0") graphical color display with touchscreen control]**.

6. The meter shall provide integrated I/O with at least 8 digital inputs, 2 digital outputs, and 2 relay outputs for equipment status/position monitoring and equipment control/interface. The digital (pulse) output operation shall provide kWh / kVARh total/imported/exported energy consumption.
7. The meter shall accept up to four field installable I/O modules. Each digital I/O module shall provide 6 digital status/counter inputs and 2 Form C relay outputs rated at 250 V, 8 A. Each analog I/O module shall provide 4 inputs configurable to 4-20 mA or 0-30V ranges and 2 outputs configurable to 4-20 mA or 0-10V ranges.
8. The meter shall provide multi-port Ethernet and serial communications with at least 2 Ethernet ports and 2 RS485 serial ports. The Ethernet ports shall support IPv4 and IPv6 with DHCP IP address assignment and offer E-mail on alarm, E-mail interval energy data, customizable web server, SNMP network management with traps, and PTP and NTP time synchronization. The meter shall provide an Ethernet-to-serial RS-485 gateway function. Industrial communication protocols supported by the meter shall include Modbus, DNP3, and IEC 61850. The meter shall provide enhanced cybersecurity features that include but are not limited to HTTPS in accordance with TLS 1.2.
9. To comply with cybersecurity directives, the meter shall have the ability to independently enable or disable communication ports, enable or disable communication protocols per communications port, and assign TCP/IP port numbers per communications protocol. The meter shall support secure protocols that include HTTPS in accordance with TLS 1.2. The meter shall provide a Security log to capture security related events such as log-in / log-out (whether successful or failed), configuration changes, resets, and other events identifying the date and time of the event and the user name of the requestor. The meter shall support Syslog protocol to deliver security events to a network management server. The meter design shall include a Trusted Platform Module (TPM).
10. The meter shall be capable of self-identification on an Ethernet network without any device configuration or user interaction.
11. The on-board logging capability of the meter shall have non-volatile time stamps with on-board logging of I/O conditions, min/max values, energy and demand, maintenance data, alarms, and any measured parameters; trending and short-term forecasting of energy and demand. The meter shall have the ability to record any parameter in the meter, and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity in which the meter has the capability of learning set-point limits based on the system behavior). The meter shall support user defined recording intervals down to ½ cycle. The number of records (depth), and overflow conditions (stop-when-full or circular) shall be user programmable and limited only by available memory.
12. The meter's on-board web server shall provide access to real-time values, power quality information, and basic meter configuration. The waveform viewing capability shall provide the ability to visualize all voltage and current phases of captured waveforms concurrently using a standard web browser; allows waveform selection, voltage and current phase selection, zooming in and out, panning with select zoom, saving and printing. The web interface shall be fully customizable with support for user defined web views.
13. The meter shall provide set-point driven alarming capability. The meter shall be able to generate an E-mail notification on an alarm condition. Alarm entries shall have millisecond resolution timestamps. The meter shall support consecutive high-speed triggers for alarms and waveform recording, triggering on a cycle-by-cycle basis with no "dead" time between events (i.e. no need for a re-arming delay time between events). The meter shall operate relays or initiate data logging captures on alarm conditions. The meter shall control any number of digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes. The meter shall provide the capability to combine any logical combination of available set-point conditions to control an internal or external function/event.
14. The meter shall provide a time-stamped event log (1 ms resolution) with support for at least 500 events, programmable up to a maximum of 20000 events. The meter shall record date and time, cause and effect, and priority for each event; The meter shall record all events relating to set-point activity, relay operation, configuration, and self-diagnostics. The event recording response

time shall be ½ cycle (8.3ms 60Hz, 10ms 50Hz) for high-speed events and 1 second for other events. The meter shall be capable of receiving time synchronization signals to ensure that the time stamps between devices on the same communications network are within +/- 1 ms; Precision time synchronization methods shall include GPS clock via RS485 serial port, IRIG-B (unmodulated) via digital input, and Precision Time Protocol (PTP) via Ethernet.

15. The meter's power quality analysis and compliance monitoring shall be fully IEC 62586, Edition 2 (2017) PQI-A compliant. The meter shall provide the following capabilities without separate software: Display statistical indicators of power quality on the front display; Provide statistical indicators of power quality that include, but are not limited to, voltage dips and swells, harmonics, frequency, rapid voltage change and mains signaling in accordance with EN 50160:2010 (Edition 4) power quality standard and provide an indication of pass / fail in a web interface. Concurrently with the EN50160 power quality analysis, the meter shall provide statistical indicators of power quality that include, but are not limited to, total harmonic distortion for voltage and current, total demand distortion for voltage and current in accordance with IEEE519:2014 power quality standard and provide an indication of pass / fail in a web interface. The meter shall compare power quality parameters (present, average or calculated values) with an absolute or relative setpoint, and alert (via e-mail or pager), or enable control (via a local interface to PQ mitigation equipment/control systems through relays and analog or digital outputs) when set-point is exceeded. The meter shall be certified by a third party laboratory to the power quality standards IEC 61000-4-30, Edition 3 Class 'A' and IEC 61000-4-15 (Flicker) according to IEC 62586-2, Edition 2. The meter's low pass anti-aliasing signal filters shall meet the requirements of IEC 61000-4-7.
  - a. The meter shall simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings. The rate shall be 1024 samples per cycle waveform recording, with minimum 17/20 microsecond transient capture (60/50 Hz). The meter shall provide the ability to record sixty (60) cycles with thirty (30) cycles prior to the fault at 1024 samples per cycle minimum. The meter shall be configurable to provide up to 225 COMTRADE disturbance capture files for waveforms that are available via FTP and provide client notification of new captures through IEC 61850 (RDRE logical node). The meter shall have the ability to record over a minute of 1-cycle RMS values every ½-cycle for voltage, current, frequency, power, power factor and unbalance, based on a power system event, and record 30-seconds of 1-cycle RMS values prior to the event trigger.
16. The meter shall provide high-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance. The meter shall detect disturbances less than one cycle in duration. The meter shall have the ability to determine the location of a disturbance more quickly and accurately by identifying the direction of the disturbance relative to the meter. The disturbance direction shall be captured in the device's event log, along with a timestamp and confidence level indicating level of certainty.
17. The meter shall provide a graphical flexible programming capability with programmable modules that access metered and input data. The meter shall be capable of deriving values and combinations of measured or calculated parameters, using arithmetic, trigonometric, logic, thermocouple linearization and temperature conversion functions. The meter shall have programming modules that can be arbitrarily linked together to create application functionality such as totalizations, efficiency measurements, load aggregation, control functions, load shedding, demand response, power factor correction, and compliance monitoring. The meter shall have the ability to read data from networked Modbus devices for the purposes of logging, exporting, aggregation, totalization, display visualization, web visualization or other user defined functions.

## 2.5 ADVANCED POWER QUALITY METERS [NOT USED]

- A. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: PowerLogic ION7650 by Schneider Electric, [2<sup>nd</sup> manufacturer] or [3<sup>rd</sup> manufacturer].
- B. The metering device used to monitor medium voltage mains for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall have at minimum the following features:
1. Voltage and current inputs—3 phase inputs; direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; 5 A nominal current inputs.
  2. Supported measured and calculated metering parameters—four-quadrant metering, full range of 3 phase voltage, current, power and energy measurements, percentage unbalance, power factor (true and displacement per phase and 3 phase) demand (minimum/maximum, present demand interval, running average demand, and predicted demand), total harmonic distortion (THD), individual current and voltage harmonics readings.
  3. High accuracy standards—meets stringent IEC and ANSI measurement accuracy standards such as IEC 62053-22 Class 0.2S, ANSI C12.20 0.2 Class 10 and 20.
  4. High-visibility display with the following characteristics:
    - a. User programmable to display up to 4 quantities per screen.
    - b. Capable of displaying graphical metering data such as phasor diagrams, watt-hour disk simulator, spectral components etc.
    - c. Capable of displaying harmonics content (THD, K-factor, crest-factor) in histogram format.
  5. Input/outputs—provide at least 4 digital inputs and 4 digital output for equipment status/position monitoring and equipment control or interfacing (e.g. Pulse output relay operation for kWh/kVARh total/imported/exported). Provide at least 4 analog 4-20 mA inputs.
  6. Communications Capability—multi-port serial and Ethernet communications with at least 2 Modbus serial ports and 1 Ethernet port offering e-mail on alarm, web server, and an Ethernet-to-serial RS-485 gateway able to serve as a Modbus Master in a communication network, either through reading and logging data from other Modbus devices, or serving as a Modbus serial to Ethernet gateway.
  7. On-board logging:
    - a. Non-volatile time stamps with on-board logging of I/O conditions, minimum/maximum values, energy and demand, maintenance data, alarms, and all measured parameters; trending and short-term forecasting of energy and demand.
    - b. Ability to record all parameters in the meter and trigger multiple such recordings in continuous succession (triggered manually or through internal event conditions, including periodic timers or set-point activity).
    - c. Continuous recording of intervals from 100 years down to one-half (½) cycle.
    - d. Number of records (depth) and overflow conditions (stop-if-full or circular) shall be programmable
  8. On-board web server can be used for:
    - a. Access to real-time values and basic power quality information using standard web browser.
    - b. Basic meter configuration.
  9. Alarming capabilities:
    - a. Set-point driven alarming capability in which the meter has the capability of learning set-point limits based on the system behavior.

- b. Generate an email notification upon an alarm condition.
  - c. Millisecond resolution timestamp on alarm entries.
  - d. Support consecutive high-speed triggers for alarms and waveform recording, triggering on a cycle-by-cycle basis with no “dead” time between events (i.e. no need for a re-arming delay time between events).
  - e. Operate relays or initiate data logging captures on alarm conditions
  - f. Control all digital output relays in an AND or an OR configuration, using pulse mode or latch mode operation, for control and alarm purposes.
  - g. Combine all logical combinations of available set-point conditions to control an internal or external function/event.
10. Time-stamped event log (1 ms resolution) with the following characteristics:
- a. Support at least 500 events, programmable up to a maximum of 20000 events.
  - b. For each event, record date and time, cause and effect, and priority.
  - c. Record all events relating to set-point activity, relay operation and self-diagnostics.
  - d. Capable of synchronizing time stamps between devices on the same serial communications network to within 100 ms.
  - e. Minimum event recording response time is one-half ( $\frac{1}{2}$ ) cycle (8.3ms 60Hz, 10ms 50Hz) for high-speed events and 1 second for other events.
  - f. Programmable set-point events.
11. Power quality analysis and compliance monitoring:
- a. Without separate software, have the following capabilities:
    - 1) Display statistical indicators of power quality on the front display.
    - 2) Compare power quality parameters (present, predicted, average, or calculated values) with an absolute or relative set point, and alert (via e-mail or pager), or enable control (via a local interface to power quality (PQ) mitigation equipment/control systems through relays and analog or digital outputs) if set-point is exceeded.
    - 3) Support EN50160 reporting for compliance monitoring.
  - b. Third party laboratory tested to the power quality standards—IEC 61000-4-30 Class 'A' 2nd edition, IEC 61000-4-15 – Flicker.
  - c. Low pass anti-aliasing signal filters to meet the requirements of IEC 61000-4-7:2002.
12. Fault recording and waveform capture:
- a. Simultaneously capture voltage and current channels for sub-cycle disturbance, transients, as well as multi-cycle sags, swells and outages in quick succession, without dead time between recordings.
  - b. 1024 samples per cycle waveform recording, minimum 17/20  $\mu$ s transient capture (60/50 Hz).
  - c. Configurable to provide COMTRADE waveforms for all captures.
13. Disturbance detection:
- a. High-speed sag/swell detection of voltage disturbances on a cycle-by-cycle basis, providing duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance.
  - b. Detect disturbances less than one cycle in duration.

- c. Determine the location of a disturbance more quickly and accurately by determining the direction of the disturbance relative to the meter. Capture analysis results in the event log, along with a timestamp and confidence level indicating level of certainty.
- d. Programmability:
- e. Capable of deriving values for combinations of measured or calculated parameters, using arithmetic, trigonometric, logic, thermocouple linearization, and temperature conversion functions.
- f. Capable (through a graphical flexible programming language) of creating programmable modules with metered and input data, through arithmetic and logic operations (such as minimum, maximum, set point, digital input, digital output, etc.) that can be arbitrarily linked together to create application functionality.

## 2.6 METERING CABINETS [NOT USED]

- A. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: Square D PowerLogic Metering Cabinet by Schneider Electric, [2<sup>nd</sup> manufacturer] or [3<sup>rd</sup> manufacturer].
- B. Any metering enclosed cabinets supplied shall meet the following specifications:
  1. Minimum UL type 1 listed steel enclosure with factory-supplied knockouts.
  2. Lockable and provide for the application of a security seal.
  3. Enclosure shall be rated NEMA [Type 1] [Type 3R].
  4. Single set of incoming terminals for connecting the voltage metering leads.
  5. Control power and voltage sensing power separated for distribution to each meter from main set of incoming terminals.
  6. External control power transformers not required for any power systems up to, and including, 480 volts.
  7. Standard wiring harnesses for control power and voltage sensing to connect each meter internally. The harness may daisy chain the voltage connections from meter to meter on each row of meters. Finger safe terminals to terminate the meter end of the wiring harness.
  8. Common daisy chain wiring for communications wiring, with a single loop for all meters connected to the circuit and each end terminated in a common location. Communication wiring installed such that interference from the power wiring is minimized.
  9. Shorting terminal blocks for connecting the current transformer leads from the field to all ordered meters. Factory installed wiring harness shall be provided to connect the CT circuit from the shorting block to the meter. Shorting terminal blocks and wiring harness shall not be required for meters for meters compatible with low voltage current transducers.
  10. Capability to field-install meters without cutting or splicing the voltage or communication wiring harnesses to be provided.
  11. Terminal blocks for incoming and outgoing communications circuit connections.

## 2.7 ELECTRICAL POWER MANAGEMENT SYSTEM [NOT USED]

- A. The equipment specified herein shall provide the necessary communications connectivity and functionality required to support the functionality of an Electrical Power Management System (EPMS). This shall include, but not be limited, to the following:
  1. Communications connectivity using the specified Ethernet network and protocols of the EPMS and related EPMS connected equipment necessary to provide functionality. Equipment may be connected through a communications gateway as shown or specified; otherwise Ethernet and protocol connectivity shall be provided within the equipment.

2. Compliance with Cyber security requirements.
  3. Remote EPMS application functionality for equipment configuration[ and operational control]; electrical power monitoring; power quality monitoring, compliance and correction; and alarm monitoring with event log.
  4. Refer to the Electrical Power Management System specification section for additional requirements.
- B. Native EPMS software compatibility shall be fully factory-tested, and shall include the following characteristics.
1. Capability for pre-engineered, interactive graphical display screens to view and analyze real-time device data.
  2. Pre-mapping of registers to standard measurement names without the need for additional configuration or internal device registers.
  3. Automatic collection and logging of device data by EPMS software without additional configuration.
  4. Refer to the individual power and energy meter device requirements for EPMS monitoring of measured and calculated values, alarms, events, parameters and additional data as available from the device, as specified herein and within the Electrical Power Management System specification.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section [26 00 10][16010] and Drawings.
- B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- D. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
- E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- F. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory trained manufacturer's representative field service engineer. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment. Report to the Engineer any discrepancies or issues with the installation.
- G. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

END OF SECTION [26 27 13.16][16295]

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