SECTION 26 09 13.11 [16295]
ELECTRICAL POWER MONITORING AND CONTROL EQUIPMENT

Schneider Electric
PowerLogic ION9000T Meter Specifications
Advanced Power Quality Monitor with Revenue Meter Accuracy

PART 1 GENERAL

1.1 SUMMARY

A. Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for electrical power monitoring and control equipment as required for the complete performance of the work, and as shown on the Drawings and as herein specified.

1.2 REFERENCES

A. General: 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.

B. American National Standards Institute (ANSI):

1. ANSI C12.20, "American National Standard for Electricity Meters - 0.1, 0.2 and 0.5 Accuracy Classes – Part 5.5.4 Accuracy tests and Part 5.5.6 Harmonics influence tests."

2. ANSI / ISA – 61010-1, "Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General Requirements."

3. ANSI / ISA – 61010-2-030, "Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-030: Particular requirements for equipment having testing or measuring circuits."

C. Canadian Standards Association (CSA):

1. CAN/CSA C22.2 No. 61010-1, "Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General Requirements."

2. CAN/CSA C22.2 No. 61010-2-030, "Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-030: Particular requirements for equipment having testing or measuring circuits."

D. CENELEC (European) Standards (EN):

1. EN 50160, "Voltage Characteristics of Electricity Supplied by Public Electricity Networks."

2. EN 55011/CISPR11, "Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement."

3. EN 55022/CISPR22, “Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.”

4. EN 55032/CISPR32, “Electromagnetic compatibility of multimedia equipment – Emission requirements.”

5. CLC/TR 50579, “Electricity metering equipment (a.c.) - Severity levels, immunity requirements and test methods for conducted disturbances in the frequency range 2 kHz-150 kHz.”

6. EN 61557-12, “Electrical safety in low voltage distributions 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: Power metering and monitoring devices (PMD).”

7. EN 61326-1, “Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements.”

8. EN 62059-32-1 “Electricity Metering Equipment - Dependability - Part 32-1: Durability - Testing of the stability of metrological characteristics by applying elevated temperature.”

E. Federal Communications Commission (FCC):

1. Title 47 CFR Part 15, Subpart B, "Radio Frequency Devices."

F. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. ANSI/IEEE C37.90.1, "Surge Withstanding Capability (SWC) Tests for Relays and Relay Systems Associated with Electrical Power Apparatus."

2. IEEE 519, “Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.”

3. IEEE 802.3, “Standard for Ethernet.”

4. IEEE 1588, “Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.”

5. IEEE 1815, “Electrical Power Systems Communications – Distributed Network Protocol (DNP3).”

G. Industry Canada (IC) Standards, Interference Causing Equipment Standard (ICES):

1. ICES-003, “Information Technology Equipment (including digital apparatus)- Limits and Methods of Measurement.”

H. International Electrotechnical Commission (IEC):

1. IEC 61000-6-5, “Electromagnetic compatibility (EMC) - Part 6-5 : Generic standards - Immunity for equipment used in power station and substation environment.”

2. IEC 61000-3-2, “Electromagnetic compatibility (EMC) -Part 3-2: Limits - Section 2: Limits for harmonic current emissions (equipment input current ≤16 Amperes per phase).”

3. IEC 61000-3-3, “Electromagnetic compatibility (EMC) -Part 3-3: Limits - Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤16 A. per phase and not subject to conditional connection.”

4. IEC 61000-4-2, “Electromagnetic compatibility (EMC) Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test.”

5. IEC 61000-4-3, “Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.”

6. IEC 61000-4-4, “Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test.”

7. IEC 61000-4-5, “Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test.”

8. IEC 61000-4-6, “Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.”

9. IEC 61000-4-7, “Electromagnetic Compatibility (EMC) - Part 4-7: Testing and measurement techniques; General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto.”

10. IEC 61000-4-8, “Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test.”

11. IEC 61000-4-11 “Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests."

12. IEC 61000-4-12, “Electromagnetic compatibility (EMC) - Part 4-12: Testing and measurement techniques - Ring wave immunity test.”

12a IEC 61000-4-15, “Electromagnetic compatibility (EMC) - Part 4-15: testing and measurement techniques - Flickermeter - Functional and design specifications.”

13 IEC 61000-4-18 “Electromagnetic compatibility (EMC) – Part 4-18: Testing and measurement techniques – Damped oscillatory wave immunity test.”

14. IEC 61000-4-30, “Electromagnetic Compatibility (EMC) - Part 4-30: Testing and measurement techniques; Power quality measurements methods.”

15. IEC 61010-1, “Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General Requirements.”

16. IEC 61010-2-030, “Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-030: Particular requirements for equipment having testing or measuring circuits”

17. IEC 61850, “Communication networks and systems for power utility automation.”

18. IEC 62052-11, “Electricity metering equipment (ac) - General requirements, tests and test conditions - Part 11: Metering equipment.” (Edition 2 to be published in 2018)

19. IEC 62052-31, “Electricity metering equipment (ac) - General requirements, tests and test conditions – Safety requirements.”

20. IEC 62053-22, “Electricity metering equipment (ac) - Particular Requirements - Part 22: Static meters for active energy (Classes 0,1 S, 0,2 S and 0,5 S).” (Edition 2)

21. IEC 62053-23, “Electricity metering equipment (ac) - Particular Requirements - Part 23: Static meters for reactive energy (Classes 2 and 3).”

22. IEC 62053-24, “Electricity metering equipment (ac) – Particular requirements – Part 24: Static meters for reactive energy at fundamental frequency (classes 0,5 S, 1 S and 1).”

23. IEC 62586-1, “Power quality measurement in power supply systems - Part 1: Power quality instruments (PQI).”

24. IEC 62586-2, “Power quality measurement in power supply systems – Part 2: Functional tests and uncertainty requirements.”

25. IEC 61588, “Precision clock synchronization protocol for networked measurement and control systems.”

I. Underwriters Laboratories, Inc. (UL):

1. UL. 61010-1, “Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General Requirements.”

2. UL 61010-2-030, “Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-030: Particular requirements for equipment having testing or measuring circuits.”

3. UL 508A, “Industrial Control Panels.” (product supports installation in UL 508A rated industrial panels)

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 01 - General Requirements.

B. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.

C. Shop Drawings: Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer’s standard product data.

D. Wiring Diagrams: Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.

E. Operation and Maintenance Data: Submit operation and maintenance data for electrical power monitoring and control equipment to include in operation and maintenance manuals specified in Division 01 - General Requirements.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of electrical power monitoring and control equipment of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of five years. The product test and calibration process shall be part of a quality program that is certified to ISO 9001.

2. Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing electrical power monitoring and control equipment similar in type and scope to that required for this Project and shall be approved by the manufacturer.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

C. Pre-Installation Conference: Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, manufacturer's representatives, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Architect.

D. Single Source Responsibility: Obtain electrical power monitoring and control equipment and required accessories from a single source with resources to produce products of consistent quality in appearance and physical properties without delaying the work. Any materials which are not produced by the manufacturer shall be acceptable to and approved by the manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. 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 lot number, if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The PM (Power Monitoring) instrument shall be a "PowerLogic™ ION9000" manufactured by Schneider Electric or equivalent.

2.2 ADVANCED POWER QUALITY MONITOR WITH REVENUE METER ACCURACY ANALYSIS

A. General Provisions:

1. Setup parameters required by the PM instrument shall be stored in nonvolatile memory and retained in the event of a control power interruption.

2. The PM instrument may be applied in four-wire wye, three-wire wye, three-wire delta, direct delta, and single-phase systems.

3. The PM instrument shall be fully supported by PM software.

B. Markings:

1. The PM instrument shall be CE marked and comply with the applicable EU directives.

2. The PM instrument shall be marked as UL compliant with the applicable UL standards.

C. Standards Compliance:

1. The PM instrument shall comply to the following safety/construction standards:

a. CAN/CSA C22.2 No. 61010-1.

b. CAN/CSA C22.2 No. 61010-2-030.

c. IEC 61010-1.

d. IEC 61010-2-030.

e. IEC 62052-11.

f. IEC 62052-31.

g. UL 61010-1.

h. UL 61010-2-030.

I IEC 62586-1

2. The PM instrument shall comply to the following electromagnetic immunity standards at levels consistent with those outlined in the construction standards:

a. ANSI/IEEE C37.90.1 (all inputs tested).

b. IEC 61000-4-2 (Electrostatic discharge immunity).

c. IEC 61000-4-3 (Radiated, radio-frequency, electromagnetic field immunity).

d. IEC 61000-4-4 (Electrical fast transient/burst immunity).

e. IEC 61000-4-5 (Surge immunity).

f. IEC 61000-4-6 (Immunity to conducted disturbances, induced by RF fields).

g. IEC 61000-4-8, (Power frequency magnetic field immunity test).

h. IEC 61000-4-11 (Voltage dips, short interruptions and voltage variations immunity).

i. IEC 61000-4-12 (Ring wave immunity).

j. IEC 61000-4-18 (Damped oscillatory wave immunity)

k. CLC/TR 50579 (Conducted disturbances immunity 2 kHz-150 kHz)

3. The PM instrument shall comply to the following electromagnetic emission standards:

a. FCC Title 47 CFR Part 15 (Subpart B, Class B: Class B digital device, radiated emissions).

b. EN 55011/CISPR11 (radiated/conducted emissions, Group 1, Class B).

d. EN 55032/CISPR32 (radiated/conducted emissions, Class B).

e. ICES 003 (industry Canada, ICES Class B digital device, radiated/conducted emissions).

f. IEC 61000-3-2 (limits for harmonic currents emissions; equipment input current less than 16 amperes per phase).

g. IEC 61000-3-3 (limitation of voltage fluctuations and flicker in low voltage supply systems for equipment with rated current less than 16 amperes).

4. The PM instrument shall comply to the following measurement standards with third party compliance certification as noted:

a. ANSI C12.20, Class 0.1 (Accuracy tests 1-9, 11, 13, 14 & Harmonic influence Tests 39-44). Third party certified.

b. IEC 62586-2, PQI-A-FI1. Third party certified.

c. IEC 61000-4-30, Class A. Third party certified.

d. IEC 62053-22, Class 0.1S. Third party certified.

e. IEC 62053-23, Class 2. Third party certified.

f. IEC 62053-24, Class 0.5S.

g. IEC / EN 61557-12, PMD-A.

5. The PM instrument shall comply to the following communications standards with third party compliance certification as noted:

a. EIA/TIA-485.

b. IEC 61850 – parts 6, 7-1, 7-2, 7-3, 7-4 and 8-1. Third party certified.

c. IEEE 802.3

d. IEEE 1815 (DNP3 - Distributed Network Protocol).

e. Modbus Interoperability.

f. IEEE 1588 / IEC 61588 (Precision Time Protocol).

D. Voltage Inputs:

1. The PM instrument shall have no less than six (6) voltage measurement terminals including four (4) phase, one (1) neutral and one (1) earth / ground inputs.

2. The PM instrument, in its standard configuration, shall be able to accept direct low voltage connections up 347 VLN / 600 VLL (UL) and 400 VLN /690 VLL (IEC) without need for potential transformers.

3. The PM instrument shall be able to withstand 3300 volts AC RMS for 2 seconds without damaging the device.

E. Current Inputs:

1. The PM instrument shall have no less than five (5) current inputs.

2. The PM instrument in its standard configuration shall accept currents with nominal values of 1A, 2A, 5A, 10A and 20A.

3. The PM instrument shall withstand an over current of 500 amperes for 1 second.

F. Control Power:

1. The PM instrument shall be able to accept a wide range of control power inputs the range of 90 V AC to 480 V AC +/- 10% (45 to 65 Hz), 90 V AC to 120 V AC +/- 10% (400 Hz) or 110 V DC to 480 V DC +/- 10% without need for a control power transformer.

2. The PM instrument shall have the ability to sustain operation through a control power outage of 200ms (12 cycles), typical, and ensure events resulting in a control power outage will be captured.

G. Mechanical:

1. PM instrument shall support multiple mounting configurations including DIN rail mounting without a display, DIN rail mounting with a remotely mounted display, and panel mounting with or without a display.

2. The PM instrument and display shall support panel mounting using a 30.5 mm round hole (M30 punch), and four (4) 3.8 mm holes, and only require a #2 Phillips screwdriver.

3. The PM instrument, without a display, shall mount on a TS35 (EN 60715) “top had” (35mm x 7.5mm) DIN rail without the need for tools.

4. The PM instrument remotely mounted display shall support mounting in a ¼ DIN, 92 x 92 mm (3.622” x 3.622”), cutout or mounting using a 30.5 mm round hole (M30 punch).

5. The PM instrument display shall have a minimum installation criterion rating of UL/NEMA Type 12 and IP65 when properly installed.

6. The PM instrument shall have removable connectors for voltage inputs, control power, communications, inputs, and outputs.

7. The PM instrument shall provide captured screw terminals for the current measurement inputs that accommodate ring terminals, spade terminals and stripped wire.

8. The PM instrument shall have terminal covers for control power, voltage inputs, and current inputs.

9. The PM instrument shall allow the installation of a wire seal to provide tamper detection for voltage inputs, current inputs, control power, the meter's case, USB ports and the installation of the meter and display on a panel.

H. Environmental:

1. The PM instrument shall have an operating temperature rating of -25 to 70 ºC (-13 to 158 ºF).

2. The PM instrument display shall have an operating temperature rating of -25 to 60 ºC (-13 to 140 ºF).

3. The PM instrument and display shall be installable in environments up to 3000 meters (9843 feet), relative humidity of 5% to 95% non-condensing (to a maximum dew point of 37 ºC), pollution degree 2.

4. The PM instrument and accessories shall be fully compliant with RoHS European directive ensuring the product does not include any of the six (6) substances stated in the directive.

5. The PM instrument and accessories shall be fully compliant with the REACH European regulation ensuring the product does not include any of the identified Substances of Very High Concern (SVHC).

6. The PM instrument manufacturer shall provide, on request, a Product Environmental Profile (PEP) that provides a list of material, a recycling rate and a calculation of eleven environmental impacts such as raw material, energy consumption, carbon footprint and damage to the ozone layer that spans the entire product life cycle, from manufacture to end of working life.

7. The PM instrument manufacturer shall provide, on request, an End of Life Instruction guide (EoLI) providing clear instructions for recycling and disposal of the PM instrument at the end of its working life.

8. The PM instrument shall have conformal coating of its internal circuitry for increased robustness of installations exposed to high degrees of humidity.

I. Measured Values:

1. The PM instrument shall provide at a minimum the following voltage values:

a. Voltage L–L per-phase.

b. Voltage L-L three-phase average.

c. Voltage L–N per-phase.

d. Voltage three-phase average.

e. Voltage percent unbalanced.

2. The PM instrument shall provide at a minimum the following current values:

a. Current per phase.

b. Current neutral (measured).

c. Current three-phase average.

d. Current percent unbalanced.

3. The PM instrument shall provide at a minimum the following power values:

a. Real power (per phase, three-phase total).

b. Reactive power (per phase, three-phase total).

c. Apparent power (per phase, three-phase total).

d. Power factor - true (per phase, three-phase total).

e. Power factor - displacement (per phase, three-phase total).

4. The PM instrument shall provide at a minimum the following energy values:

a. Accumulated energy (real kWh, reactive kVARh, apparent kVAh) (signed/absolute).

b. Incremental energy (real kWh, reactive kVARh, apparent kVAh) (signed/absolute).

c. Conditional energy (real kWh, reactive kVARh, apparent kVAh) (signed/absolute).

d. Energy by quadrant (real kWh, reactive kVARh, apparent kVAh).

5. The PM instrument shall be able to provide a minimum/maximum value for any measured parameter.

6. The PM instrument shall be capable of deriving values for any combination of measured or calculated parameter, using the following arithmetic, trigonometric, and logic functions:

a. Arithmetic functions; division, multiplication, addition, subtraction, power, absolute value, square root, average, maximum, minimum, RMS, sum, sum-of-squares, unary minus, integer ceiling, integer floor, modulus, exponent, PI.

b. Trigonometric functions; COS, SIN, TAN, ARCCOS, ARCSIN, ARCTAN, LN, LOG10.

c. Logic functions; =, =>, <=, <>, <, >, AND, OR, NOT, IF.

d. Thermocouple linearization functions; Type J, Type K, Type R, Type RTD, Type T.

e. Temperature conversion functions; C to F, F to C.

J. Demand:

1. The PM instrument shall be able to provide last completed interval demand, predicted demand, peak demand with date and time, and coincident demand values on multiple demand channels.

2. The PM instrument shall be able to perform multiple accepted demand calculation methods, including, but not limited to, block, rolling block, and thermal demand with user-programmable demand period lengths.

3. The PM instrument shall support the synchronization of the demand interval using a digital input, a command via communications, or internal clock.

K. Accuracy:

1. The PM instrument shall meet ANSI C12.20 accuracy Class 0.1, current class 2, 10 and 20.

2. The PM instrument shall meet IEC 62053-22 accuracy Class 0.2S and Class 0.1S with nominal current of 1A and 5A and maximum current of 20A. (standard pending).

3. The PM instrument shall meet IEC 62053-24 accuracy Class 0.5S with nominal current of 1A and 5A and maximum current of 20A.

4. The PM instrument shall meet IEC 62053-23 accuracy Class 2.0S with nominal current of 1A and 5A and maximum current of 20A.

5. The PM instrument shall provide four-quadrant metering fully compliant with IEC 61557-12 PMD.

L. Sampling:

1. The PM instrument shall continuously sample all voltage and current inputs at 1024 samples per cycle for nominal frequencies of 50Hz and 60Hz.

2. The PM Instrument shall be able to perform sag/swell detection of voltage disturbances on a half-cycle basis, providing the duration of the disturbance, the minimum, maximum, and average value of the voltage for each phase during the disturbance. Disturbances less than one cycle in duration can be detected.

3. The PM instrument shall continuously sample all voltage inputs at 10 MHz (166,667 samples per cycle at 60 Hz or 200,000 samples per cycle at 50 Hz).

4. The PM instrument shall be able to perform high-speed transient detection of impulsive and oscillatory transients having a duration of 100 nanoseconds or longer and having a magnitude up to 10,000 volts. Statistics shall be provided for each high-speed transient to include date/time, peak voltage magnitude, average voltage, duration, rise-time, voltage stress (volts seconds), accumulated voltage stress from all high-speed transients, count of high-speed transient events per phase, and categorization of high-speed transients by magnitude and duration.

M. Logging:

1. The PM instrument shall have a minimum of 2 GB of non-volatile memory for configuration settings, log data, alarms, events, waveform captures, web pages, and documents.

2. The PM instrument shall store critical internal and revenue data upon power loss.

3. The PM instrument shall retain all data and configuration in non-volatile memory for 15 years without control power.

4. The PM instrument shall provide a real-time clock (RTC) with battery backup that will provide ride-through of at least 7 years without control power.

5. The PM instrument shall have a field installable battery for real time clock ride-through that can be installed without need to remove the instrument from the installation.

6. Onboard meter clock shall be able to be paced by a choice of sources, including, but not limited to: GPS (RS485), IRIG-B, Precision Time Protocol (PTP), Network Time Protocol (NTP/SNTP), power line, or internal clock.

7. The PM instrument shall have a time-stamped event log with the following features:

    a. The number of records shall be user programmable up to 20000 events.

    b. Each event shall be recorded with the date and time of the event, the cause and effect of the event, and the priority of the event.

    c. Events relating to setpoint activity, relay operation, and self-diagnostics shall be recorded in the event log.

    d. Events relating to security activity such as successful or unsuccessful user log-in attempts, configuration changes, and resets shall be recorded in the event log.

    e. Time stamps shall have a resolution of 1 millisecond.

    f. Time stamps can be synchronized to within +/- 1 millisecond between devices through the use of PTP (Precision Time Protocol), GPS (Global Positioning Satellites) serial input, or IRIG-B digital input.

    g. Minimum event recording response time shall be 1/2 cycle (8.3 ms 60 hertz, 10 ms 50 hertz) for high speed events and 1 second for other events.

    h. The priority of setpoint events shall be programmable.

8. The PM instrument shall be able to log any parameter in the meter, including, but not limited to, minimum/maximum and waveforms.

9. The PM instrument shall be capable of supporting a minimum of 50 independent data logs that support the following configuration options:

    a. Recording method of Fill and Hold or First In First Out (FIFO).

    b. Selection of up to 16 parameters per log.

    c. Log data on an event or based on internal clock.

d. Ability to automatically fill gaps in data logs with a value of zero (0) or leave blank.

N. Alarming:

1. The PM instrument shall have the ability to support a minimum of 65 setpoint driven alarms evaluated once per second or once every ½ cycle, user configurable.

2. The PM instrument shall have the ability to support disturbance alarms for detecting voltage and current dips and swells on all monitored phases.

3. The PM instrument shall be able to generate an E-mail on an alarm condition.

4. The PM instrument shall have millisecond time stamp resolution on alarm entries.

5. The PM instrument shall be able to adjust alarm setpoints based on the alarm quantity (alarm setpoint learning).

a. The user shall be able to enable the PM instrument to learn the characteristics of normal operation of metered values and select alarm setpoints based on this data.

b. The quantities to be learned shall be user selectable, including, but not limited to, standard speed alarms, high speed alarms, and disturbance alarms.

c. The user shall be able to configure this feature using one of two modes:

1) Manual: Once the learning is completed, the recommended values shall be stored for review and manual installation.

2) Automatic: Once the learning is completed, the recommended values shall be automatically installed and operational.

d. The learning period shall be user configurable from 1 to 365 days to ensure system stability prior to determining the recommended setpoints.

6. The PM instrument shall support consecutive high-speed alarm conditions which shall trigger on a cycle-by-cycle basis with no delay time between events (i.e., no need for a rearming delay time between events).

7. The PM instrument shall be able to operate relays on alarm conditions.

8. The PM instrument shall be able to initiate data log captures on alarm conditions.

9. The PM instrument shall be able to control digital output relays using pulse mode or latch mode operation for control and alarm purposes.

10. The PM instrument shall be able to combine any logical combination of any number of available setpoint conditions to control any internal or external function or event.

O. Communications:

1. The PM instrument shall be capable of supporting the following physical, communications methods simultaneously and independently:

a. Ethernet (dual-port, single network).

1) 10/100 Base-TX (port 1).

2) 10/100 Base-TX (port 2).

b. Ethernet switch.

1) 10/100 Base-TX (port 1).

2) 10/100 Base-TX (port 2).

c. Ethernet switch with RSTP (Rapid Spanning Tree Protocol).

1) 10/100 Base-TX (port 1).

2) 10/100 Base-TX (port 2).

d. Serial.

1) RS-485 (port 1).

2) RS-485 (port 2).

2. The PM instrument shall support multiple concurrent Ethernet communication protocols over an Ethernet network at any one time:

a. IEC61850.

b. DNP 3.0 TCP/IP.

c. DLMS.

d. Modbus TCP/IP.

e. Modbus TCP/IP mastering of Ethernet devices.

f. ION TCP/IP.

g. Ethernet to serial line gateway.

h. SFTP (file transfer).

i. HTTP / HTTPS (web interface).

j. PTP (precision time protocol).

k. NTP / SNTP (time synchronization).

l. SMTP (E-mail).

m. SNMP (network management with traps).

n. DHCP (automatic IP address assignment).

o. Syslog (to push security events to a remote server).

p. MV-90 compatibility.

3. The PM instrument shall support any one of the following serial communications protocols on any one serial port at any one time:

   a. Modbus:

      1) Modbus RTU.

      2) Modbus mastering of Serial RS-485 slaves.

   b. DNP 3.0.

   c. DLMS.

   d. ION.

   e. MV-90 compatibility.

4. The PM instrument shall be able to support at least 32 concurrent Modbus TCP/IP connections.

5. The PM instrument shall have a Modbus TCP/IP gateway to provide a network connection to Modbus serial devices connected to a serial port on the instrument.

6. The PM instrument shall have the ability to read from and write to Modbus devices connected to a serial port on the instrument and on a common local area Ethernet network.

7. The PM instrument shall serve web pages with the following capabilities to:

   a. Provide real-time data in both tabular and graphical formats.

   b. Provide a histogram of harmonic data through the 63rd harmonic.

   c. Provide an ITIC (CBEMA) and a SEMI E10 summary of voltage disturbances.

   d. Provide a NEMA motor derating curve.

   e. Provide a phasor diagram representation of the electrical connections to the meter.

   f. Provide a summary of EN 50160 power quality data along with a pass / fail analysis.

   g. Provide a graphical trend for voltage, average current, frequency and power demand along with a forecast of the next 4 points.

   h. Provide the ability to visualize all voltage and current phases of captured waveforms concurrently using a standard web browser. Waveform viewer allows waveform selection, voltage and current phase selection in any combination, zoom in, zoom out, panning with selected zoom, saving and printing.

   i. Support the ability to provide technical documents, images and drawings.

   j. Support user defined web pages containing data from the host meter as well as data from Modbus devices connected to a serial port on the instrument and on a common local area Ethernet network.

k. Provide the ability to visualize statistics for high-speed impulsive and oscillatory transients to include characterization of high-speed transients by magnitude and duration, number of high-speed transients per phase and total, and accumulated voltage stress per phase.

8. The PM instruments shall have two (2) Ethernet ports that support both IPv4 and IPv6.

9. The PM instruments shall automatically provide E-mail notifications for alarms and scheduled system status updates based on user configuration. E-mail messages sent by the PM instruments shall be able to be received like any ordinary E-mail message.

10. The PM instrument shall have the ability to push historical logs through the Ethernet communication port to a remote server based on a user defined schedule or an event.

11. The PM instrument shall have the ability to support SNMP with a standard MIB2 and custom MIB, and be capable of sending traps to an SNMP server when alarm conditions are detected.

12. The PM instrument shall be able to automatically acquire an IPv4 and IPv6 address assignment from a DHCP server.

13. The PM instrument shall support Syslog protocol to allow it to send detected security events to a remote server.

14. The PM instrument shall provide an IEC 61850 compliant communications interface with the following features:

a. Four (4) concurrent client connections.

b. File based setup via FTP.

c. Network time sync via NTP.

d. Configurable reports, including, but not limited to, selectable dataset member and configurable dead band values.

e. Support four (4) buffered reports and twenty (20) unbuffered reports (one (1) buffered and five (5) unbuffered per client).

f. Map up to 16 analog and/or 16 digital calculated values for reporting in IEC 61850.

g. Fault capture data for three-phase voltage and current in COMTRADE format, including, but not limited to, the following:

1) Up to 225 COMTRADE fault capture files.

2) The files shall be downloadable via standard FTP client.

3) The device shall support client notification through IEC 61850 to signal when new fault captures have been created and are available (RDRE logical node).

h. The following logical nodes shall be supported in addition to LLNO and LPHD (mandatory):

1) MHAI; harmonics.

2) MMTR; metering.

3) MMXU; measurement.

4) MSQI; sequence and imbalance.

5) MSTA; metering statistics.

6) GGIO; the ability to view data from and control all I/O points in the meter.

7) RDRE; disturbance recorder function.

15. The PM instrument shall have the ability to announce its presence on a local network segment using Device Profile Web Services (DPWS) over IPv6 local addressing without user interaction. The instrument shall be viewable in a Microsoft™ Windows™ Windows Explorer window view of network devices as a link that will provide access to the instrument's web interface.

16. The PM instrument shall have the ability to request and receive a precision time synchronization message through the Ethernet network using PTP (precision time protocol) in compliance with IEEE 1588 / IEC 61588 standards supporting the PTP default profile.

P. Security

1. The PM instrument 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.

2. The PM instrument shall support secure protocols that include HTTPS (in accordance with TLS 1.2) and SFTP.

3. The PM instrument 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.

4. The PM instrument shall support Syslog protocol to deliver security events to a network management server.

5. The PM instrument design shall include a Trusted Platform Module (TPM).

6. The PM Instrument shall have multi-level security which shall support customized access for up to 50 users.

7. The PM instrument shall have revenue security capabilities, including, but not limited to, the following:

a. Password protected, no hardware lock, or

b. Password protected and hardware locked, or

c. The following data shall be protected from alteration when locked:

1) kWh and kVARh (import, export, net and total).

2) kVAh (import, export, net and total).

3) kW, kVAR, kVA demand (block and sliding window).

4). kWh, kVARh, kVAh pulse outputs.

8. The PM instrument shall be field upgradeable with a digitally signed update file.

9. The PM instrument shall provide a physical lock switch that will preserve all meteorological configuration values to ensure accurate and consistent energy metering.

10. The PM instrument shall provide the ability to secure its meteorological lock switch as well as all voltage, current and control power inputs with tamper detectable wire seals.

Q. Input and Output Options:

1. The PM instrument shall be capable of having up to 32 digital inputs capable of one (1) millisecond timing resolution.

2. The PM instrument shall be capable of receiving unmodulated IRIG-B time synchronization protocol through integrated digital inputs to ensure system wide time accuracy.

3. The PM instrument shall have four (4) Form A digital outputs that support pulse output operation for kWh total, kWh imported, kWh exported, kVARh total, kVARh imported, kVARh exported, and kVAh values.

4. The PM instrument shall have an optical test output that is compliant with IEC 62052-11.

5. The PM instrument shall be capable of supporting up to four (4) field installable option modules to expand digital and analog I/O capabilities without need for additional control power sources.

6. The PM instrument shall be capable of having up to ten (10) Form C relays which shall be isolated for up to 3200 volts AC (2 seconds), with reinforced isolation rated for 300 V. Overvoltage Category II. The relays shall support maximum current of eight (8) amperes continuous for 250VAC or five (5) amperes continuous for 24 volts DC for 20,000 cycles (resistive load).

7. The PM instrument shall be capable of having up to sixteen (16) Analog inputs which shall be isolated and support inputs of four (4) to twenty (20) milliamps or zero (0) to thirty (30) volts DC.

8. The PM instrument shall be capable of having up to eight (8) Analog outputs of four (4) to twenty (20) milliamps or zero (0) to ten (10) volts DC range.

R. Display:

1. The PM instrument shall have two (2) graphical color display options: a 96x96 mm (3.5”) color graphical pushbutton controlled display and a 197x175 mm (7.0”) color graphical touchscreen display.

2. The two (2) PM instrument display options shall both mount in the same manner, utilizing the same panel cutout of 30.5 mm round hole (M30 punch), and have the ability to be panel mounted with the meter in a back-to-back configuration.

3. The PM instrument 96x96 mm display shall be a 320 x 240 pixel backlit color graphical LCD display, TFT, 8.9 mm (3.5 in.) diagonal, with a UL type 12 / IP54 rating.

4. The PM instrument 197x175 mm touchscreen display shall be a WVGA (800 x 480 pixel) backlit color graphical LCD display, 178 mm (7.0 inches) diagonal, with UL type 12 / IP65 rating that includes:

    a. A projected capacitive touch panel that allows operation with an electrical safety gloved hand.

    b. Provisions to optionally allow control power from an auxiliary 24 Vdc power supply.

5. The PM instrument displays shall have a -25 to 60 ^{o}C operating temperature at < 3000 meters (9843 ft) above sea level.

6. The PM instrument displays shall allow remote mounting up to 100 meters (330 feet) from the PM instrument or be mounted on a panel with the PM instrument back to back.

7. The PM instrument display shall connect to the PM instrument and be powered through a single standard Cat5/5e unshielded twisted pair cable.

8. The PM instrument shall be capable of presenting all real-time parameters on the instrument’s display.

9. The PM instrument shall have a user-programmable custom display that shall be capable of displaying up to six (6) quantities on a single screen.

10. The PM instrument shall be capable of displaying advanced graphical representations of metering information, including, but not limited to, harmonic histograms, phasor diagrams, and bar graphs.

11. The PM instrument shall be able to display measurements in either IEC or IEEE formats.

12. The PM instrument display shall support multiple languages, including, but not limited to, English, French, Spanish, German, Italian, Portuguese, Russian, and Chinese.

13. The PM instrument shall be able to present the following display screens:

    a. Numeric: Display 2, 3, 3 with timestamp, 4, or 6 parameters on a single screen.

    b. Event Log: Display recent events written to the PM instrument’s event log, including, but not limited to, diagnostic events.

    c. Nameplate: Display information in a tabular format (default nameplates shall show Owner, and meter details).

    d. Bar: Display up to three (3) real time numeric parameters along with their upper and lower extremes.

e. Histogram: Display harmonics content in histogram format, including, but not limited to, 2nd to 63rd harmonic, THD (total, even, odd); ability to select and display magnitude and angle for individual harmonics

f. Phasor: Display current and voltage phase information in a phasor diagram format, including tabular display of magnitudes and angles.

g. Inputs and Outputs: Display digital input and output status, and analog input and output values.

h. Alarm: Display a listing of active and historical alarms and events.

i. Waveform: Display voltage and current waveforms captured by the meter based on measured disturbances, events or manual trigger.

S. Field Configuration: The PM instrument shall be configurable as follows:

1. Provide voltage input scale, voltage mode (wye, delta, single-phase), current input scale, auxiliary input and output scales, and communications setup parameters that shall be configurable from the instrument's display, or via web pages.

2. Basic parameters described above, plus additional setpoint and data log setup parameters may be programmed via the communications port using a PC.

3. Custom configuration of operating parameters shall be possible through a graphical, flexible programming language.

4. The configuration of the device shall be done using programmable modules. The modules shall be linked together in an arbitrary manner to create arbitrary functionality. Some example module types include, but shall not be limited to, minimum, maximum, setpoint, digital input, and digital output.

5. Programming through a computer shall be secured by user ID and password.

6. Programming through the instrument's display shall be secured by password.

7. Programmability shall be sectioned such that when the meter is sealed it shall still be configurable to an extent that does not affect the accumulation of revenue metering related data.

T. Power Quality Analysis and Compliance Monitoring:

1. Without the use of separate software, the PM instrument shall be able to measure power quality in accordance with IEC 61000-4-30, Class A.

2. The PM instrument shall be certified by a third party as compliant with IEC 61000-4-30 Class A, Edition 3 in accordance with IEC 62586-2.

3. The PM instrument shall be certified by a third party as compliant with IEC 62586-1.

4. Without using separate software, provide statistical indicators of power quality that include, but are not limited to voltage dips and swells, harmonics, interharmonics, frequency, flicker, 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.

5. Without the use of separate software, the PM instrument shall make available the statistical indicators of power quality provided by EN 50160 on the instrument's display, or via communications protocols such as ION, Modbus RTU, Modbus TCP/IP, or via web pages.

6. Concurrently with the EN50160 power quality analysis, 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 IEEE 519:2014 power quality standard and provide an indication of pass / fail in a web interface.

7. The PM instrument shall be capable of monitoring and comparing the value of any statistical indicator of power quality (present, predicted, average, or otherwise manipulated value) with an absolute or relative setpoint. When such setpoint is exceeded, an alert shall be issued via E-mail or pager, or control shall be enabled via a local interface to mitigation equipment or control systems through relays and analog or digital outputs.

8. The PM instrument shall support symmetrical components.

9. The PM instrument shall be third party Laboratory certified 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.

10. The PM instrument shall include low pass anti-aliasing signal filters meeting the requirements of IEC 61000-4-7.

U. Fault recording and Waveform Capture:

1. The PM instrument 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.

2. The PM instrument shall be able to perform 1024 samples per cycle waveform recording to support 17/20 microsecond transient capture (60/50 Hz).

3. The PM instrument shall have twenty-one (21) programmable oscillographic waveform recorders. Each waveform recorder shall have the following features:

   a. Able to record a digitized representation of any phase voltage or current signal with no dead time between such recordings, and the ability to trigger multiple such recordings in continuous succession, and at different resolutions simultaneously.

   b. Enabled and triggered manually or through internal operating conditions, including, but not limited to, periodic timer or setpoint activity.

   c. Half-cycle triggering shall be supported for waveform recorders.

   d. The number of records (depth) of each data recorder, and the overflow conditions (stop-when-full or circular) shall be programmable.

   e. Ability to record sixty (60) cycles with thirty (30) cycles prior to the fault at 1024 samples per cycle minimum.

4. The PM instrument shall be able to record continuously to capture long duration waveforms. The duration of the waveform capture shall be limited by memory alone.

5. The PM instrument 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).

6. The PM instrument shall provide a web interface for viewing captured waveforms with the ability to display any combination of or all recorded voltage and currents channels concurrently, display the value and time stamp of any point along the waveform, provide zooming, panning and allow panning with a user selected zoom.

V. High-Speed Data Logging:

1. The PM instrument shall be capable of recording high-speed values containing one (1) cycle of RMS data updated every half (1/2) cycle.

2. The PM instrument shall be able to record over 1 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 up to 30 seconds of 1-cycle RMS values prior to the event.

3. The PM instrument shall be able to initiate a high-speed data capture based on a setpoint condition, user programmed logical condition, or command received via communication.

4. The PM instrument shall be capable of capturing high-speed logs concurrently with a waveform capture.

W. High-speed Transient Data Logging:

1. The PM instrument shall be capable of recording high-speed transient waveforms with a duration up to one (1) cycle (20 milliseconds) with up to 50 microseconds prior to the event trigger.

2. The PM instrument shall be capable of triggering a coincident disturbance waveform capture and a high-speed RMS (1/2 cycle) capture with each high-speed transient event.

3. The PM instrument shall provide statistics on all high-speed transient events to include date/time, peak voltage magnitude, average voltage, duration, rise-time, voltage stress (volts seconds), accumulated voltage stress (per phase and total), count of high-speed transient events per phase, and a categorization of high-speed transients by magnitude and duration.

X. Disturbance Direction Detection

1. 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.

2. Detect disturbances less than one cycle in duration.

3. Ability to determine the location of a disturbance more quickly and accurately by identifying the direction of the disturbance relative to the meter. Disturbance direction is captured in the device’s event log, along with a timestamp and confidence level indicating level of certainty.

Y. Programmability

1. Provide a graphical flexible programming capability with programmable modules that access metered and input data.

2. Capable of deriving values and combinations of measured or calculated parameters, using arithmetic, trigonometric, logic, thermocouple linearization and temperature conversion functions.

3. Programming modules 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.

4. 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.

Z. Advanced Features:

1. The PM instrument shall have provisions for creating periodic or non-periodic schedules for up to two (2) years. These schedules shall be used to perform the following functions:

a. Time of use (TOU).

b. Demand control.

c. Load scheduling.

d. Logging.

e. Periodic resetting.

2. The PM instrument shall have multiple tariffs and time-of-use (TOU) functionality to store and monitor up to twenty (20) years of seasonal rate schedules. The TOU feature shall allow four (4) seasons, four (4) day types (each one capable of at least eight (8) switch times, with a resolution of one (1) minute). The TOU feature shall support four (4) rate tariffs, and at least twelve (12) holidays per year, and shall allow periodic self-read capability.

3. The PM instrument shall be capable of providing consumption and rate of usage information with user defined units of measure from pulse inputs and analog inputs to support metering of utilities such as water, air, gas, electricity and steam (WAGES).

PART 3 EXECUTION

3.1 EXAMINATION

A. 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 Architect, 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.

1. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 INSTALLATION

A. Install electrical power monitoring and control equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.

3.3 DEMONSTRATION

A. Provide the services of a factory-authorized service representative of the manufacturer to provide start-up service and to demonstrate and train the Owner's personnel.

1. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

2. Train the Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.

3. Review data in operation and maintenance manuals with the Owner's personnel.

4. Schedule training with the Owner, through the Architect, with at least seven day's advanced notice.

3.4 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to the Installer, that shall ensure that the electrical power monitoring and control equipment shall be without damage at time of Substantial Completion.

END OF SECTION