1.1 POWER QUALITY METERING – ADVANCED POWER QUALITY METER

A. 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 four (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 five (5) inputs and support nominal input currents of both 5 A and 1 A.

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 6 parameters per screen. The meter shall be capable of displaying graphical metering data including at minimum spectral components and phasor diagrams. The meter shall be capable of displaying harmonics content in histogram format. The meter shall provide a minimum of two (2) display options consisting of a 96x96 mm (3.8”) graphical color display with push-button control, and a 197x175 mm (7.0”) graphical color display with touchscreen control.

6. The meter shall provide integrated I/O with at least eight (8) digital inputs, four (4) digital outputs, and two (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 have the ability to add optional field expandable I/O modules of at least twenty-four (24) digital inputs with wetting source, eight (8) form-C relay outputs, sixteen (16) analog inputs and/or eight (8) analog outputs.

8. The meter shall provide multi-port Ethernet and serial communications with at least two (2) Ethernet ports and two (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.

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 and SFTP. 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 millisecond 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 millisecond; 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.

16. 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 180 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.

17. 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.

18. The meter shall provide 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. Waveforms of high-speed transients shall be captured with a duration up to one (1) cycle (20 milliseconds) with 50 microseconds prior to the event trigger. It shall be possible to trigger a coincident disturbance waveform capture and a high-speed RMS (1/2 cycle) capture with each high-speed transient event. 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.

19. 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.