READ THIS FIRST

Notice to the Design Engineer, this document is part of Facilities and Infrastructure standards for Electrical Systems. Designers are advised to NOT use this template (*.doc) document as part of any project contract documents. Designers shall use the Port of Seattle MasterSpec specifications from the following link:

https://www.portseattle.org/page/guide-specifications.

Designers shall edit the corresponding Port's MasterSpec specification to meet the F&I Electrical Standard outlined in this specification. Note that Port's MasterSpec specifications contain specifications and languages for both Aviation and Maritime Divisions. F&I Standards are strictly for Aviation Division, and any Maritime related specs or languages should be removed from the project specifications.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY AND NOTES TO DESIGNER

A. Section includes the components for power metering and monitoring.

B. Electrical meters serve the following functions:

1. Revenue metering.
2. Recording existing load data prior to adding new load to a panel.
3. Determining if circuited loads are still in use.
4. Tracking electrical energy usage throughout the airport.

C. The Port requires a power meter on every panelboard. Typically, the panel is metered at the upstream breaker that feeds it. Metering shall be accomplished via one of the two methods listed below:

1. Multi-point meter installed in the distribution panel feeding the new panel.
2. One individual meter per panel, mounted in a meter enclosure.

D. The Port requires Branch Circuit metering on all 120/208V panelboards rated 225A and less.

1. Exception: ADR Tenant panels do not require branch circuit metering.

E. All new meters installed on the Port electrical system must be ethernet-capable and have built-in embedded Web server. All new meters will be networked onto the ICS LAN.

1. Where electrical room contains a cabinet with a network switch, new meter communication cables can be routed to the cabinet in the electrical room.
2. Where electrical room does not contain a cabinet with a network switch, the project shall route communication cable in 1" conduit to the nearest electrical room, with 20' service loop provided in cable tray.

F. During the Design phase, the designer shall perform a site investigation with an F&I Electrical Engineer and representatives of the POS AVM Electric Meter shop to determine location of meter and details of meter installation.

G. During the Construction phase, the contractor shall perform a plan-in-hand site walk with an F&I Electrical Engineer and representatives of the POS AVM Electric Meter shop to ensure correct installation of meter. The F&I Utility Electrical Engineer may perform the engineering role; when a tenant revenue meter is to be installed, the F&I Utility Electrical Engineer shall be included in the site walk.

1. Designer shall include requirement for contractor site walk in project drawing notes and/or specifications.
2. Electrical Shut-down requests will not be approved until contractor site walk is complete.

H. Meters installed on Port power systems (other than tenant-revenue meters): Perform field investigation and coordinate with F&I to determine which of the following scenarios fits a specific project.

1. Double ended unit substation – meters are required on both main breakers and all feeder breakers.
    a. New unit substations:
        1) Meters for main breaker shall be installed in the cubicle above each main breaker.
        2) Meters for feeder breakers shall be installed in the top row of cubicles which are reserved for metering.
    b. New breakers in existing unit substations:
        1) A meter is required for every new breaker in a unit substation. The meter shall be installed in a top row cubicle reserved for metering.
        2) Existing spare meters may be available. Perform field investigation to determine if a spare meter is available or to otherwise locate an available space in which to install a new meter.
2. New Switchboards and Distribution boards:
    a. Provide Multi-point metering consisting of:
        1) Multipoint Meter base
        2) Multipoint Meter Modules
            a) Provide quantity of modules required to accommodate CT inputs from all breakers and breakers spaces on panel.
        3) Energy Portal Module, Web enabled Ethernet communications module
        4) Current sensors
            a) Provide CTs with 10mA output for feeder breakers rated up to 400A.
            b) For feeder breakers rated greater than 400A, provide CTs with 333mV output and interface modules as required to connect to meter modules.

3. Existing Switchboards and Distribution boards:
    a. Provide a PXM 3000 meter for every feeder to a panelboard.
        1) Install meter in existing meter cabinet or
        2) Provide a meter cabinet adjacent to or contiguous with switchboard or distribution board.
        3) Cabinet shall be sized to accommodate the meters required by the project (one meter for each panel fed from associated switchboard or distribution panel) plus space for future meters. Coordinate with F&I on acceptable spare capacity for each project/meter cabinet.
            a) Meter cabinet sized for 4 meters minimum.
            b) Single meter enclosure will be allowed with approval of F&I. This will be allowed only if space is extremely limited and there is no perceived opportunity for future growth.
            c) Meter cabinet shall contain fused disconnects and CT shorting blocks for each meter and for each future meter space.
        4) Provide fused disconnects and CT shorting blocks for all meters and for all spare meter spaces.
        5) Large meter cabinets (sized for more than six meters) will require a network switch and patch panel and shall be sized to accommodate a future UPS.
        6) Meter cabinets shall be sized and installed so that the no meter is installed lower than 36” from center of meter to level of finished floor and no meter is installed higher than 72” from center of meter to level of finished floor.
        7) Installation of MPM or meter cabinet shall be determined on a case-by-case basis. Multipoint meter system is the preferred option, however a meter cabinet may be installed based on costs, operational impacts, age of equipment, etc.
    b. Multi-point meter may be installed for existing switchboards and distribution boards. Installation must include all components required for functional meter a described in Product section of this document.
4. New Panelboards:
    a. All new Port and tenant panelboards require a meter. Typically, the meter is installed at the switchboard or distribution board that feeds the new panel. Field investigation will determine how and where the new meter is installed.
    b. MultiPoint meter;
        1) If distribution panel feeding new panel is equipped with Multi-point meter and integral CTs, new panelboard will be metered via existing multi-point meter.
        2) New panelboard will require MPM or BCM for monitoring feeder breakers or branch circuit breakers, depending on voltage and amperage rating of panelboard.
        3) If additional CTs are required to monitor newly added panel, CTs shall be provide as follows:
            a) Provide 10mA output CTs for feeder breakers rated 400A or less.
            b) Provide 333mV output CTs for feeder breakers rated greater than 400A up to 2000A. Provide interface modules as required by manufacturer to connect CT output to meter module.

c) Where there is insufficient space inside panel enclosure for the interface modules, designer shall coordinate with F&I Electrical to determine enclosure location for CTs and interface modules.

4) Designer to identify all required components including additional meter cards to add metering to an existing multipoint meter and clearly components and installation requirements on design documents.

5) Designer to ensure that maximum cable lengths as defined by manufacturer are not exceeded.

I. Tenant Revenue Meters:

1. Tenant meters will be installed by electrical contractor then inspected and energized by Port of Seattle meter shop electricians. Electrical contractor shall complete site inspection with Port utility electrical engineer and Port meter shop electricians to identify appropriate meter installation which meets requirements of design documents and Port electrical standards, and in particular, all applicable requirements of the NEC. Supply power may be locked out by POS until the meter has been inspected.
2. Tenant's designer shall provide a design for installation of the tenant meter. Design shall comply with POS Electrical Standards requirements as detailed above.
   a. Design drawing shall show all components necessary for meter installation including supply power and communication cabling.
   b. Designer shall perform a site inspection with the POS Electricians to determine the location of meter and to identify source for reference voltage and control power.
      1) Application for electrical connection will not be approved until site inspection with POS Electric shop has been performed.
3. Meter shall be installed near switchboard or distribution board that feeds the tenant panel.
   a. Where tenant distribution switchboard or distribution board is equipped with multi-point metering, existing multipoint metering shall be used for new tenant panel.
   b. Where distribution panel does not have multi-point metering, tenant meter shall be installed in meter cabinet.
4. New meters:
   a. Install new meter in an existing meter cabinet if possible.
   b. If no existing meter cabinet with space is available, design shall include a new meter enclosure sized for minimum (4) meters. Coordinate meter enclosure size and location with F&I.
      1) Meter cabinet shall contain fused disconnects and CT shorting blocks for each meter and for each future meter space.
      2) Where space is limited, a single meter enclosure may be permitted. Coordinate with F&I.
5. Existing meters can be used, if compliant with section 1.2-I.
6. Where distribution panel feeding new tenant panel is equipped with MPM, the tenant panel shall be metered via the MPM.
   a. Tenant project shall verify capacity on existing MPM modules. Project shall provide new meter module and all other necessary components including CTs, as required for fully functional metering of new tenant panel.

J. Existing Meters:

1. Existing Eaton PXM meters may be reused.
2. Existing Cutler Hammer IQ200 series meters, existing Westinghouse IQ Data Plus and all glass enclosed revenue are considered to be at end of life and shall be replaced with new Eaton digital Ethernet capable meters as specified in section below.
    a. Existing meters that are to be replaced must be demolished. It is not acceptable to abandon meters in place.
    b. Where glass meters are removed, a meter jumper must be installed. Eskstrom JC6BUL or equivalent.
3. Existing MPM meters may be reused. Ensure MPM has adequate number of meter modules, CTs and CT modules.

K. Branch Circuit Monitoring:

1. Where one branch circuit panel serves multiple tenants, or where a panel will serve both Port spaces and at least one tenant space, new panels shall be installed with branch circuit monitoring.

L. Existing Panels

1. Where new loads are added to existing branch circuit panels and new loads are required to be metered, the existing panel may be retrofit with Branch Circuit Monitoring.
2. Branch circuit metering retrofit may either be refit with modular current sensor strips or individual CTs. Panel space is most likely the determining factor in selection of either current sensor strips or individual CTs. This will also influence meter base style selection. Designer to meet with F&I Electrical Engineering to determine appropriate branch circuit monitoring configuration for retrofit application.

M. Metering Components: All PXM meter installations shall include the following:

1. Fused disconnect to allow equipment to be de-energized prior to maintenance or repair.
2. CT shorting blocks.
3. Control power transformers where required.
4. 2-1/2 Element meters are not allowed.

N. System includes the following components:

1. PXM Meters.
2. MultiPoint Meters (MPM)
3. Branch Circuit meters (PX BCM)
4. Current Transformers.
5. Electricity Meters.
6. Shorting Terminal blocks – required for all meter CT inputs.
7. Fused disconnect – required for all meters.
8. Control Power Transformers.
9. Network Switch (furnished and installed by POS ICT)
10. Communication network and interface modules for Modbus TC/ICP data transmission protocols.

O. Meters shall be specified for applications as follows:

1. Medium Voltage Unit Substations and Switchgear (12.47kV):
   a. Main Breakers: PXM 8000.
   b. Feeder Breakers: PXM 6000.
2. Low Voltage Power Centers (480V)
   a. Main Breakers: PXM 6000
   b. Feeder Breakers: PXM 3000
3. Low Voltage Switchboards and Distribution Boards 1200A-2000A:
   a. Main breaker shall be metered by PXM 3000 installed at power center feeder breaker
   b. Feeders shall be metered via multipoint meters or PXM meters as outlined above.
4. Low Voltage Panelboards:
   a. PX BCM Branch Circuit Monitoring shall be installed on all new 208V panelboards rated less than 225A.

P. Related Sections:

1. Section 261116.11 “Secondary Unit Substations Switchgear”
2. Section 262300 “Low-Voltage Switchgear”
3. Section 262413 “Switchboards”
4. Section 262416 “Panelboards”.

1.3 DEFINITIONS

A. BCM: Branch Circuit Monitoring

B. CT: Current Transformer

C. Ethernet: Local area network based on IEEE 802.3 standards.

D. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.

E. HMI: Human-Machine Interface.

F. HTML: Hypertext markup language.

G. I/O: Input/output.

H. LAN: Local area network; sometimes plural as "LANs."

I. LCD: Liquid crystal display.

J. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.

K. Modbus TCP/IP: An open protocol for exchange of process data.

L. MPM: Multi-point metering.

M. PC: Personal Computer; sometimes plural as “PCs.”

N. PM: Power monitoring.

O. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

P. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.

Q. RS-485: A TIA standard for multipoint communications using two twisted-pairs.

R. Smart Facility System: data historian and reporting system for the acquisition, processing, communication and display of equipment status data, meter parameters, power quality data, event and alarm signals, event logs and reports.

S. TCP/IP: Transmission control protocol/Internet protocol incorporated into Microsoft Windows.

T. THD: Total harmonic distortion.

U. UPS: Uninterruptible power supply; used both in singular and plural context.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
2. Provide technical data sheets, installation manuals and user documentation manuals that describe the product installation and operation, physical data, electrical characteristics and connection requirements of the power monitoring equipment and cabinet components.

B. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Enclosure types and details.
2. Project specific cabinet layout, including location of all devices, terminal blocks and wireways.
3. Project specific wiring and schematic diagrams, clearly identifying internal and field wiring connections and requirements.
4. Project specific system diagram, identifying all network interface devices.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For qualified manufacturer.

E. Field quality-control reports.

F. Other Informational Submittals:

1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.

G. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Operating and applications software documentation.
2. Software licenses.
3. Software service agreement.
4. Manufacturer’s specification sheets, operating specifications, design guides, user's guides for software and hardware in electronic PDF format.

H. Software and Firmware Operational Documentation:

1. Self-study guide describing the process for setting equipment's network address; setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.
2. Device address list and the set point of each device and operator option, as set in applications software.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer: A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project with minimum three years successful in-service performance.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. The vendor is accredited to ISO 9001 quality assurance standards during the design and manufacturing of the PM instruments.

4. The PM instruments are calibrated at the factory using instruments that are certified to have been calibrated using standards whose accuracies are traceable to the National Institute of Standards and Technology (NIST).
5. The metering cabinet will be UL certified and labeled as an assembly, fabricated and tested by a UL 508 Certified assembly shop.
6. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100 and marked for intended use for the location and environment in which they are installed.
7. Comply with NFPA 70, as adopted and administered by the Authority Having Jurisdiction.

B. Instrument Certifications

1. Certified to UL 22CZ
2. CE marked.

1.6 WARRANTY

A. The PM instrument is warranted by the vendor against manufacturing defects for a period of one year.

B. The PM software is warranted by the vendor against manufacturing defects for a period of one year.

C. Warranty service may be performed by the manufacturer or authorized service representative.

D. The vendor provides technical support service. These services include the following:

1. Technical consultation via telephone for up to three hours per month for the duration of the warranty period.
2. Free upgrades to new firmware for the PM instruments for the duration of the warranty period.
3. Free upgrades to new software releases for the duration of the warranty period.

E. The vendor manufactures functionally equivalent replacement units for PM instruments for a period of not less than ten years following the installation of the original equipment.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver PM system components in shipping splits in sizes that can be moved past obstructions in delivery path.

B. Deliver PM system components in fully enclosed vehicles after specific environmental conditions have been permanently established in spaces where components are to be placed.

C. Store PM system components indoors in clean, dry space with uniform temperature controlled within manufacturer's ambient temperature and humidity tolerances for non-

operating equipment to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances and physical damage.

1.8 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Meters: Eaton PXM 20006000/8000 series, PXMP, or PXBCM depending on application. Eaton Power Xpert PXBCM
2. Multi-Point Metering: Eaton Power Xpert PXMP
3. Network Switch: Network switch(es) shall be furnished and installed by Port of Seattle ICT.
4. Cabinet: Eaton, Hoffman, or approved equal.

2.2 SYSTEM REQUIREMENTS

A. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.

B. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.

2.3 POWER METERS

A. Separately mounted, permanently installed instrument for power monitoring.

1. Meter shall support 3-element wye, 2.5 element wye, 2 element delta, 4 wire delta systems.
2. Surge withstand shall conform to IEEE C37.90.1 and ANSI C62.41 (6 kV).
3. The meter shall be user programmable for voltage range to any CT or PT ratio.
4. Meter shall have a burden of not more than 0.01 VA per phase maximum at 10 amps.
5. All inputs and outputs shall be galvanically isolated to 2500 VAC.
6. NEMA 12 faceplate rating shall be available for power meter.

B. Manufacturer: EATON PXM series, no substitutions.

C. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor installation in spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

D. Power Meter Readings

1. The meter shall provide user configured fixed window or rolling window demand. This shall allow the user to set up the particular utility demand profile.
2. Readings for kW, kVAR, kVA and power factor shall be calculated using utility demand features.
3. All other parameters shall offer max and min capability over the user selectable averaging period.
4. Meter shall show instantaneous voltage max and min reading displaying the highest surge and the lowest sag seen by the meter.
5. The meter shall provide upgrade rates of 6 cycles for watts, VAR and VA. All other parameters shall be 60 cycles.

E. rms Real-Time Measurements:

1. Current: Each phase, neutral, average of three phases, percent unbalance.
2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
3. Power: Per phase and three-phase total.
4. Reactive Power: Per phase and three-phase total.
5. Apparent Power: Per phase and three-phase total.
6. Power Factor: Per phase and three-phase total.
7. Displacement Power Factor: Per phase and three-phase total.
8. Frequency.
9. THD: Current and voltage.
10. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
11. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
12. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

F. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:

1. Present.
2. Running average.
3. Last completed interval.
4. Peak.

G. Demand Real Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

H. Demand Reactive Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

I. Demand Apparent Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

J. Average Power Factor Calculations, Demand Coincident, Three-Phase Total:

1. Last completed interval.
2. Coincident with kW peak.
3. Coincident with kVAR peak.
4. Coincident with kVA peak.

K. Power Analysis Values:

1. THD, Voltage and Current: Per phase, three phase, and neutral.
2. Displacement Power Factor: Per phase, three phase.
3. Fundamental Voltage, Magnitude and Angle: Per phase.
4. Fundamental Currents, Magnitude and Angle: Per phase.
5. Fundamental Real Power: Per phase, three phase.
6. Fundamental Reactive Power: Per phase.
7. Harmonic Power: Per phase, three phase.

8. Phase rotation.
9. Unbalance: Current and voltage.
10. Harmonic Magnitudes and Angles for Current and Voltages: Per phase, up to 40th harmonic.

L. Power Demand Calculations: According to one of the following calculation methods, selectable by the user:

1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:
   a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
   b. Fixed block that calculates demand at end of the interval.
   c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.
3. Demand Calculation Initiated by a Synchronization Signal:
   a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
   b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.
   c. Demand can be synchronized with clock in the power meter.

M. Sampling:

1. Current and voltage shall be digitally sampled at continuous sampling rate of 400 samples per cycle or greater on all channels in the meter.
2. Power monitor shall provide continuous sampling at a rate of minimum 400 samples per cycle on all voltage and current channels in the meter.
3. The meter shall use minimum 24 bit Analog to Digital conversion.

N. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:

1. Line-to-line voltage.
2. Line-to-neutral voltage.
3. Current per phase.
4. Line-to-line voltage unbalance.
5. Line-to-neutral voltage unbalance.
6. Power factor.
7. Displacement power factor.
8. Total power.
9. Total reactive power.
10. Total apparent power.
11. THD voltage L-L.
12. THD voltage L-N.

13. THD current.
14. Frequency.

O. Harmonic Calculation: Display and record the following:

1. Harmonic magnitudes and angles for each phase voltage and current through 40th order harmonic minimum. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
2. Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by user.

P. Current and Voltage Ratings:

1. The meter shall accept current inputs of Class 10 (0 to 10A), 5 Amp nominal and Class 2 (o to 2 A), 1 A nominal secondary.
2. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
3. Withstand ratings shall not be less than 15 A, continuous; 100 A, lasting over 10 seconds; 300 A, lasting five seconds; 500 A, lasting 1 second; 25% of full scale current continuous over-range capability.
4. Voltage inputs: Auto-ranging voltage inputs with a voltage rating of not less than 50 to 347 VAC plus 25%. Provisions for direct connection for wye (star) systems up to 347/600 VAC. For higher voltage systems, PTs with 120 VAC, 277 VAC or 347 VAC secondaries must be used. All voltage inputs provide:
5. 1500 VAC continuous surge protection.
6. 25% of full-scale voltage overrange capacity.
7. Frequency: Auto ranging, 50 Hz or 60 Hz.

Q. Accuracy:

1. Meter shall be a traceable revenue meter, and shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy. Comply with ANSI C12.20, Class 0.2% for revenue meters. Accuracy from Light to Full Rating shall meet the following criteria:
   a. Power and Energy: Accurate to 0.2 percent of reading.
   b. Voltage and Current: Accurate to 0.1 percent or better of reading.
      1) The meter shall provide true RMS measurements of voltage, phase-to-neutral and phase-to-phase; and current, per phase and neutral.
   c. Power Factor: 0.2 percent of reading.
   d. Frequency: Plus or minus 0.03 Hz.

R. Waveform Capture:

1. Waveform capture required for meters on circuits rated 2000A or greater at 480V and 200A or greater at 4160V and 12.47kV
2. Capture and store steady-state waveforms of voltage and current channels when user-programmed value goes out of limit and when the value returns to within limit. Each capture shall be for minimum 3 cycles, minimum 64 data points for each cycle for the 2000 series, 400 data points for each cycle for the 8000 series, allowing resolution of harmonics to 40th harmonic of basic 60 Hz.

3. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

S. Input: Minimum one digital input signal(s).

1. Normal mode for on/off signal.
2. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
3. Conditional energy signal to control conditional energy accumulation.

T. Outputs:

1. Operated either by user command sent via communication link, or set to operate in response to user-defined alarm or event.
2. Closed in either a momentary or latched mode as defined by user.
3. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
4. One digital KY pulse to a user-definable increment of energy measurement.
5. Minimum one relay output module(s), providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
6. Output Relay Control:
    a. Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
    b. Normally open and normally closed contacts, field configured to operate as follows:
        1) Normal contact closure where contacts change state for as long as signal exists.
        2) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
        3) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
        4) End of power demand interval when relay operates as synchronization pulse for other devices.
        5) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
        6) Output controlled by multiple alarms using Boolean-type logic.

U. Onboard Data Logging:

1. Meter shall have data logging capability in meters with minimum 256 megabytes of memory. The meter shall have a real-time clock which allows for time stamping all the data in the meter when log events are created.
2. The meter shall have historical logs for trending profiles. Each log shall be capable of being programmed with multiple parameters. The user shall have the ability to allocate memory between the historical logs in order to increase or decrease the memory allotted to each of these logs.
3. The meter shall have a log for Limit Alarms. The Limits log shall provide magnitude and duration of an event, time-stamp, and log value. The log must be capable of recording up to 2048 events.
4. The meter shall have a log for System Events. The System Events log shall record the following occurrences with a time stamp: Demand Resets, Password

Requests, System Startup, Energy Resets, Log Resets, Log Reads and Programmable Settings Changes.

5. The meter shall have a log for I/O changes. The I/O Change log shall provide a time stamped record of any Relay Outputs and any Input Status changes. The log must be capable of recording up to 2048 events.
6. For meters on unit substation main breakers and feeder breakers, the meter shall be capable of recording a waveform both when a user programmed value goes out of limit and when the value returns to within limit.
7. The meter shall be capable of storing 30 day load data including the peak amps, low amps, average amps and load factor for each phase.
    a. Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 and 52 days of 15-minute interval data, depending on number of quantities selected.

V. Alarms.

1. Alarm limits can be set for any measured parameter. Limits shall be based on percentage of Full Scale settings.
2. Manual relay control shall be available via software. Relay set delays and reset delays shall be available.
    a. Define pickup, dropout, and delay.
    b. Assign one of three severity levels to make it easier for user to respond to the most important events first.
    c. Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.
3. Alarm Events:
    a. Over/undercurrent.
    b. Over/undervoltage.
    c. Current imbalance.
    d. Phase loss, current.
    e. Phase loss, voltage.
    f. Voltage imbalance.
    g. Over kW demand.
    h. Phase reversal.
    i. Digital input off/on.
    j. End of incremental energy interval.
    k. End of demand interval.

W. Control Power: 90 to 265V ac or 100 to 370V DC. Universal AC/DC supply shall be available and shall have burden of less than 15VA.

X. I/O Expandability

1. The meter shall have I/O expandability through option card slots.
2. The cards shall be capable of being installed in the field without removing the meter from the installation.

Y. Communications:

1. The meter shall provide data collection, formatting and web page hosting providing all web data through an HTTP interface. The meter shall directly host the live and saved meter data without the need for any dedicated server software, active X control or Java Applets.
2. The meter shall have two communications ports.
   a. The first port shall be auto-sensing 10/100 base-T Ethernet with the following capabilities:
      1) Allow the meter to speak with 12 simultaneous sockets of Modbus TCP so that multiple requests for data can be received simultaneously.
      2) Allow auto transmit/receive detection for straight or null RJ45 cables.
   b. The second port shall provide RS485 communications speaking Modbus ACSII, Modbus RTU or DNP 3.0 protocol through back plate.
3. Communications Card: Standard, plus Ethernet RJ45 (10 Base T).
4. Provisions for flash firmware that can be field upgraded through a communications port, without decommissioning the instrument or de-energizing the circuit or equipment.

Z. Display Monitor:

1. Meter shall include a bright, easy to read display.
2. Display four values on one screen at same time. Monitor shall allow scrolling to view the following:
   a. Current, per phase rms, three-phase average and neutral.
   b. Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
   c. Real power, per phase and three-phase total.
   d. Reactive power, per phase and three-phase total.
   e. Apparent power, per phase and three-phase total.
   f. Power factor, per phase and three-phase total.
   g. Frequency.
   h. Demand current, per phase and three-phase average.
   i. Demand real power, three-phase total.
   j. Demand apparent power, three-phase total.
   k. Accumulated energy (MWh and MVARh).
   l. THD, current and voltage, per phase.
3. Reset: Allow reset of the following parameters at the display:
   a. Peak demand current.
   b. Peak demand power (kW) and peak demand apparent power (kVA).
   c. Energy (MWh) and reactive energy (MVARh).
4. Monitor shall be available in transducer only version, which shall not include a display.

AA. Environmental

1. Storage Temperature: -20°C to 70°C without damage or loss of factory warranties.
2. Operating Temperature: -20°C to 70°C without damage or loss of factory warranties.

2.4 MULTI-POINT METERING

A. Manufacturer shall install multi-point metering (MPM) in Switchboard at the factory.

1. Manufacturer shall pre-wire current sensors and interface modules to MPM.
2. Manufacturer shall pre-wire metering voltages and control power connections.
3. Manufacturer shall install optional color HMI where applicable on hinged door.

B. MPM Metering Requirements

1. ANSI C12.20 0.5 accuracy class for sub-metering of loads with 125A, 250A and 400 A solid core current sensors with voltage clamping circuits.
2. The MPM metering modules shall meet ANSI C12.20 0.5 accuracy class.
3. MPM shall have a means of supporting ANSI C57.13 5A revenue metering accuracy current transformers with the use of an interface module.
4. Metering system shall be modular in construction with capacity for up to 60 current channels configurable for 20 three phase, 30 two pole or 60 one pole loads or combination thereof.
5. The MPM design shall permit the use of; solid core 100mA sensors, split core 333mV sensors and 5A current transformers on the same MPM.
6. MPM shall support up to 80 channels of pulse metering of other utilities such as Water, Gas, Steam and chilled water.
7. Support for optional outputs to be used for alarm indication.
8. Load profile intervals shall be configurable as 1, 5, 10, 15, 30, or 60 minutes or controllable from a demand synch input.
9. Demand interval shall be configurable as fixed 1, 5, 10, 15, 30, or 60 minutes or sliding with sub-intervals of 1, 5, 10, 15 or 30 minutes.
10. Interval-by-interval data storage of demand readings shall be programmable from 1 to 60 minutes.
11. Sufficient memory for a minimum of two years of 15 minute interval data.

C. MPM Configuration

1. MPM shall include a configuration port compatible with a temporary laptop connection such as a USB interface.
2. The MPM shall be field configurable for combinations of 1, 2 or 3 pole sub-meters with the use of intuitive graphical configuration software.

D. Communications Capabilities

1. The MPM shall support two RS-485 MODBUS communications ports to facilitate simultaneous communications to a local HMI display and to a communications gateway.
2. The MPM shall support optional Ethernet communications including Modbus TCP, BACnet/IP, HTTPS, SFTP, SNMP, SMTP and NTP.

E. WEB Enabled Capabilities

1. Embedded configurable WEB server shall support individual operator usernames and passwords.
2. Web pages shall support HTTPS to protect usernames, passwords and metering data from being transmitted in the clear on communications packets.
3. Energy and Power comparisons between user selectable time periods.

4. Two years of 15 minute historical data shall be stored in .csv file formats on an SFTP directory in the embedded device.
5. Circuit dashboards shall support importing of customer one-line or plan view graphic images and configurable MPM hotspot links on the graphic linked to MPM data.
6. Dashboards shall be configurable to support user preferred dashboard views.

F. Metering Data

1. Main System or Aggregate Data - The MPM shall report the present value of metering data representing a Main circuit. The Main circuit data can be either actual metered data or a virtual main representing the aggregated loads from the sub-meters. Readings for the Main System or Aggregate meter shall include:
   a. Meter Name (32 Characters)
   b. Watts, vars and VA per phase and system
   c. Per phase Volts L-N and Volts L-L
   d. Frequency
   e. System Power Factor
   f. kWh, forward and reverse
   g. kVARh, Q1, Q2, Q3, and Q4
   h. kVAh imported (Q1, Q4) and exported (Q2, Q3)
   i. Block interval demand (1 to 60 minutes programmable)
      1) W, forward and reverse
   j. Peak interval demand with date/time of peak
      1) W, forward and reverse
   k. One minute block inter demand (one minute fixed)
      1) W, forward and reverse
   l. Minimum and maximum readings including date and time of min/max shall be reported for:
      1) Power (W), per phase and system
      2) Reactive Power (VAR), per phase and system
      3) Apparent Power (VA), per phase and system
      4) Voltage, L-N
      5) Voltage, L-L
      6) Frequency
      7) System power factor
2. Sub-Meter Readings – MPM: shall report aggregated power and energy readings for combinations of channels configured as three phase, two pole and single pole sub-meters. Readings for the Sub-meters shall include:
   a. Present RMS readings for Watts, Vars and VA (total)
   b. Aggregated power factor
   c. kW and kWh, forward and reverse
   d. kVAR and kVARh, forward and reverse
   e. kVAh imported (Q1,Q4) and exported (Q2,Q3)
   f. Block interval demand (1 to 60 minutes programmable)
   g. kVA imported (Q1,Q2) and exported (Q2Q3)
   h. Peak interval demand with date/time of peak
   i. VA imported (Q1,Q2) and exported (Q2Q3)
3. Pulse Input Module – MPM reports for up to 80 pulse input channels.

G. Alarms

1. The MPM shall support alarms for the following functions:
   a. Demand overload
   b. Main aggregate power
   c. Power factor
   d. Power outage
   e. Rate alert
   f. Submeter power
   g. Voltage limits
   h. Voltage unbalance

H. Outputs

1. The MPM shall support up to 81 digital outputs. The number of outputs is scalable depending on the number and type of metering, pulse input counting and output modules installed in each MPM.

I. Historical Data

1. MPM shall store interval based Load Profile readings in non-volatile memory which can be retrieved by MPM configuration software or accessed by the Energy Portal Module.
   a. Stored data for the main system or aggregate meter up to 60 configured submeters.
   b. Stored data for up to 81 configured pulse input channels.
2. MPM shall store an alarm log.

J. Optional HMI Display shall display data for all configured sub-meters.

1. HMI configuration shall not be required for each sub-meter. The HMI shall discover the configuration information automatically.
2. Displayed information shall include:
   a. Sub-meter name
   b. Demand reading for last interval
   c. Peak demand value with date/time of peak
   d. Aggregated power reading for any 1, 2, or 3 pole meter
   e. Aggregated energy reading for any 1, 2, or 3 pole meter
   f. Scaled pulse counts for pulse metering

2.5 BRANCH CIRCUIT MONITORING

A. Power Xpert Branch Circuit Monitor

1. Where shown on the drawings, supply a UL listed microprocessor-based Branch Circuit Monitoring System (PXBCM), or approved equal having the specified features. This system shall consist of meter base, and meter module(s) as described below.
2. The Branch Circuit Monitor shall measure the following operational data for up to 84 branch load circuits:
   a. Forward and Reverse kWh
   b. Watts, VA, Amps, Power Factor

c. Present and Peak demand readings for Amps, Forward and Reverse Watts
d. Maximum Watts, VA, Amps

3. The Branch Circuit Monitor shall support alarms for current that can be set based on percent of Breaker Rating and alarms for voltage based on percent of nominal voltage.
   a. High, High-High, Low, Low-Low non-latching alarms for current.
   b. High and Low latching alarms for current, resettable via Modbus or the WEB interface.
   c. High and Low latching and non-latching voltage alarms for each meter module input voltage.
   d. Alarm Status and alarm counters shall be available via Modbus communications.
4. Branch Circuit monitor shall support upgradeable firmware via communications.
5. The Branch Circuit Monitoring shall have the following ratings
   a. Elevation: 0 – 9843 ft (0 – 3000M)
   b. Pollution degree: 2 (IEC 60644-1)
   c. Ambient temperature range: -20°C – +70°C (-4° – +158°F)
   d. Storage temperature range: -40°C to +85°C (-40°F - +185°F)
   e. Humidity: 5% – 95% non-condensing.
   f. PXBCM as a component shall have a NEMA 1 rating. When installed in an enclosure it shall have the same rating as its enclosure NEMA [1] [3R] [4] [4X] [12].
   g. Housing ingress protection: IP20 as a component, in an enclosure the same as the enclosure
   h. CE Mark
   i. EMC (Electromagnetic Compatibility)
      1) IEC61326: EMI IEC61000-4-X level 3
      2) CISPR 11: Class B emissions, CISPR 22 (Ethernet) class B emissions
      3) FCC part 15 Class B emissions
   j. UL/cUL 61010-1 3rd edition
   k. EN61010-1
6. PXBCM Meter Base
   a. Each PXBCM-MB-BASIC Meter Base shall support connection of up to 4 Meter Modules in either a MMS Strip or MME External configuration monitoring a total of up to 100 single-phase two-wire AC loads, 48 single-phase three-wire AC loads or 32 three-phase four-wire AC loads or combinations not to exceed 25 poles per meter module.
   b. The PXBCM-MB-BASIC shall be equipped with four meter module ports. Each port shall provide control power and communications to either a PXBCM-MMS Meter Module Strip or a PXBCM-MME Meter Module External with a maximum cable length of 28ft between each Meter Base and each Meter Module.
   c. Each PXBCM-MB-BASIC shall support connection to up to 4 PXBCM-MMS Meter Module Strip or 4 PXBCM-MME Meter Module External, or a combination of up to 4 total PXBCM-MMS and PXBCM-MME each meter module with independent single or three phase voltage metering circuits with inputs up to 277V L-N and 480V L-L.
   d. PXBCM-MB-BASIC Power Supply shall be rated for 100-277VAC L:N +/- 10% CAT III, 47-63 Hz , 6W.
   e. The PXBCM-MB-BASIC shall include a 3 terminal RS-485 serial port for Modbus RTU communications and an RJ-45 port for Ethernet

communications. The Ethernet port shall support Modbus TCP communications as well as an Embedded WEB server.

f. The PXBCM-MB-BASIC embedded WEB server shall support device configuration for to up to 4 PXBCM-MMS Meter Module Strip or 4 PXBCM-MME Meter Module External, or a combination of up to 4 total PXBCM-MMS and PXBCM-MME and display of up to 100 points of metering data. It shall be possible to save device configuration information to a file for archiving and for uploading to PXBCM.

g. The PXBCM-MB-BASIC shall support connection to a pre-configured HMI via RS-485 serial port. The HMI shall not require configuration.

h. The PXBCM-MB-BASIC shall be equipped with LED's to indicate communications activity and Device/Alarm Status. An LED shall also indicate if Ethernet is configured for DHCP (automatically assigned IP address) or Fixed IP (manually assigned IP address). The PXBCM-MB shall be equipped with 2 rotary switches to assign Modbus Slave ID 1-99.

i. The PXBCM-MB-BASIC shall be equipped with security mode switches to enable the device to operate in a secure mode to prevent tampering with device configuration and resets over comms.

j. The PXBCM Meter Base shall automatically sense the type of PXBCM Meter Module connected to each of its four meter module ports.

k. The Configuration Wizard shall support naming and configuration of up 100 virtual meters by assigning 1-3 channels of current to 1, 2 or 3 pole meters. Virtual meters shall aggregate the channel data assigned to each virtual meter and report the aggregated virtual meter values for:
   1) Forward and Reverse Energy
   2) Watts, VA, Average Amps and Power Factor
   3) Average and Peak demand for Watts and VA

7. PXBCM-MMS Meter Module Strip

a. PXBCM-MMS Meter Module Strips shall be available in configurations to mount on either the left or right of a panelboard and contain 9, 15, or 21 CTs. Four additional 333mV connections shall be provided on each PXBCM-MMS for Auxiliary 333mV CT connections which can be used to monitor the panel mains or branch circuits. The MMS shall include both load current and voltage metering circuits providing meter data to the Meter Base.

b. The PXBCM Meter Module Strip shall be available with either 9 CT's, 15 CT's or 21 CT's per assembly for factory assembly into Panelboards with 18, 30 or 42 poles. PXBCM MMS CT's shall have be rated for up to 100A continuous current monitoring and designed to mount in an Eaton PRL-1a, PRS-2a or PRL-3e Panelboard with one inch breaker pole spacing.

c. PXBCM Meter Module Strip one inch center CTs shall have a window opening sufficient for insulated Aluminum conductor rated for 100A capacity.

d. The PXBCM Meter Module Strip shall support direct connection of one set of 3 phase nominal metering voltage inputs up to 277V L-N and 480V L-L voltages and shall be rated as Cat III.

e. The Meter Modules can also monitor voltage in the following configurations:
   1) Three Phase, four wire wye
   2) Three phase, three wire delta
   3) Three phase, center tapped delta
   4) Three phase, three wire
   5) Single phase, two wire

f. Power and Energy metering shall be performed based on the voltage assignment for each 100A strip mounted CT and 333mV Aux CT current input as configured using the embedded WEB server.
g. PXBCM MMS Accuracy of kWh metering on branch circuits shall be rated for ANSI C12.20 0.5 accuracy class as a system, including 100A rated strip mounted solid core current transformers. kWh accuracy for 333mV input auxiliary circuits shall satisfy ANSI C12.20 0.5 class excluding external 333mV sensor performance.
h. The PXBCM MMS shall be UL approved for mounting to the panelboard interior with no interference. Strip placement shall line up 1 inch center CT's with breaker poles and not impede the normal routing of branch circuit conductors in the panel enclosure.
i. The PXBCM MMS shall connect to the PXBCM MB using factory supplied cables.

8. PXBCM-MME Meter Module External
   a. For retrofit applications.
   b. The PXBCM Meter Module external shall support 25 channels of current using external 333mV current sensors connected to terminal strips on the PXBCM-MME.
   c. The PXBCM Meter Module External shall support direct connection of one set of 3 phase nominal metering voltage inputs up to 277V L-N and 480V L-L voltages and shall be rated as Cat III.
   d. The Meter Modules can also monitor voltage in the following configurations:
      1) Three Phase, four wire wye
      2) Three phase, three wire delta
      3) Three phase, center tapped delta
      4) Three phase, three wire
      5) Single phase, two wire
   e. Power and Energy metering shall be performed based on the voltage assignment for each 333mV current sensor input as configured using the embedded WEB server.
   f. PXBCM MMS Accuracy of kWh metering on 333mV input circuits shall satisfy ANSI C12.20 0.5 class excluding external 333mV sensor performance.
9. Optional HMI Display shall display data for all configured sub-meters.
   a. HMI configuration shall not be required for each sub-meter. The HMI shall discover the configuration information automatically.
   b. Displayed information for up to 100 circuits shall include:
      1) Sub-meter name
      2) Current
      3) Voltage
      4) Energy consumption
      5) Demand
      6) Power factor
      7) Aggregated power and energy readings for any 1, 2, or 3 pole meters

2.6 CURRENT TRANSFORMERS

A. Ratios as indicated; burdened and c-200 minimum accuracy class suitable for connected relays, revenue grade meters, and instruments unless otherwise identified.

1. Solid core type.
2. CT shall be minimum 1% accurate from 1% to 100% of the maximum full scale rating from -15°C to 60°C.
3. CT shall have #12 AWG UL 1015 rated twisted pair leads which shall be limited to the minimum length necessary to complete the circuit to the power meter.
4. Aperture of CT shall be adequate to accommodate the outside diameter of the conductors.

B. All secondary wiring connected to the CTs shall be a minimum of #12 AWG copper and should be limited to the minimum length necessary to complete the circuit to the power meter. Short length of smaller conductors in switch boards may be utilized provided the additional burden imposed by these conductors is negligible when compared to the overall circuit burden.

C. For PXM 2000 Series and 4000/6000/8000 Series Meters

1. All CTs shall be provided with 5A secondaries at the primary rated current.
   a. For panelboard (up to 400A bus) with multi-point metering application, CTs shall be small, compact, and mountable to the support frame of the panelboard.
2. CT output shall be 0-5A proportional to the maximum full scale amperage rating.
3. Current transformer shorting blocks (CTSB) shall be provided on the secondary of the current transformers to ensure that the secondary is automatically short circuited when the load is removed.
4. CT Manufacturers:
   a. 250A and smaller: ITI 2DARL
   b. Larger than 250A: ITI 5DARL
   c. Or approved equal.
5. Shorting Block Manufacturers:
   a. Marathon Special Products 1506SC
   b. Or approved equal.

D. For PX MPM Series and PX BCM Series Meters

1. Provide 100mA output CTs for circuits rated up to 400A
2. Provide split core 333mV output CTs for circuits rated 400A-2000A.
3. Manufacturers:
   a. Dent Instruments
   b. Eaton
   c. Or approved equal.

2.7 FUSED DISCONNECT

A. Disconnect switch that de-energizes fuses without shutting down. Safety type fuse holders for fusing.

1. Manufacturers:
   a. Marathon Special Products FDS-30-C-1 (single pole) and FDS-30-C-3 (three poles) or approved equal.

b. Marathon Special Products FDS-30-C-1 (single pole) and FDS-30-C-3 (three poles) or approved equal.

2.8 METER CABINET

A. Meter enclosure including control power transformers, fusible disconnect, terminal blocks, CT shorting blocks and lock for enclosure. Factory assembled and UL listed as an assembly.

1. Enclosure:
   a. NEMA 12 for indoor applications; NEMA 3R or 4X in indoor or outdoor applications where dust, water or corrosive chemicals are present.
   b. Provide hinged door with lock.
   c. Operating temperature: -20°C - +40°C.
   d. Size per project requirements.
2. Meter fusing.
3. Fused control power transformer (where required) – minimum 100VA.
4. Fusible disconnect for primary voltage.
5. CT shorting block assembly. Schneider VTFB-6 or approved equal.
6. PX Gateway (for multiple meter enclosure only).
7. Gateway power supply (where required).
8. Network switch where required.
9. Sized for future control power UPS.

B. Manufacturer: Eaton or approved equal.

2.9 NETWORK SWITCH

A. Network switch takes inputs from meters and power gateway. Switch output to nearest Port telecom room.

B. Network switch shall be furnished and installed by POS ICT.

2.10 POWER SUPPLY

A. 95 to 240 VAC (± 10%) at 47 to 440 Hz, 120 to 310 VDC, 0.2A worst case loading (12W) at 100 VAC, 25°C.

B. Manufacturer: Eaton ELC-PS02 or Eaton PSG60N24RP. No substitutions.

2.11 LAN CABLES

A. Comply with Section 271500 "Communications Horizontal Cabling."

B. Unshielded Twisted Pair Cables: Category 6 as specified for horizontal cable for data service in Section 271500 "Communications Horizontal Cabling."

2.12 LOW-VOLTAGE WIRING

A. Comply with Section 260523 "Control-Voltage Electrical Power Cables."

B. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.

1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
2. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.
4. Provide flexible SIS conductors for #8 AWG and smaller for conductors across enclosure hinges.

PART 3 - INSTALLATION

3.1 EXAMINATION

A. Prior to installation, contractor shall perform a plan-in-hand site visit with an F&I Electrical Engineer and a representative from the Port AVM Electric Meter shop.

1. Site visit will include verification of the following:
   a. Meter type and CTs to be installed
   b. Meter location.
   c. Meter wiring requirements, including CT locations, meter source power, meter reference voltage, fused disconnect location and wiring method, control power transformer (if needed) location and wiring method.
2. Electrical shut-down required for project connection will not be approved until site walk has been completed to the satisfaction of the electric shop.

B. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Install power metering cabinets and accessories according to contract drawings.

B. Comply with mounting and anchoring requirements in Section 260548.16 “Seismic Controls for Electrical Systems”.

C. Standard Mounting Height: Top of trim is 72 inches above top of floor or housekeeping pad, unless otherwise indicated.

D. Mounting: Plumb and rigid without distortion of box.

E. Provide terminal blocks in cabinet. Comply with terminal block requirements in Section 260533 “Raceways and Boxes for Electrical Systems”.

F. Install fusible disconnect that de-energizes fuse holder without de-energizing meter control power and reference voltage input.

G. Install safety-type fuse holders for fusing.

H. CT securing and supporting: Securely support CTs so that transformer leads are not bearing weight and are not under pressure.

I. Where identified on Contract documents, install metered circuits for branch load revenue metering purposes in accordance with power monitoring and data gathering system requirements. Provide power wiring between CT terminal in panelboards and switchboards and external metering cabinets.

3.3 CONNECTIONS

A. Connect all wiring as identified on contract drawings. All power supply and communications wiring connections must be performed in accordance with guidelines set out in the product documentation.

B. Where meter is mounted into an opening cover or door of enclosure, wiring is to be routed and secured neatly and in a workmanlike manner to accommodate opening and closing of door.

C. Tighten electrical connections and terminals according to manufacturer’s published torque tightening values. If manufacturer’s torque values are not available, use those specified in UL 486A and UL 486B.

D. All current and voltage sensing connections to PM instruments must be made using appropriately rated CT shorting blocks.

3.4 CABLING

A. Comply with NECA 1.

B. Install cables and wiring according to requirements in Section 271500 "Communications Horizontal Cabling."

C. Wiring Method: Install wiring in raceway and cable tray. Conceal raceway and wiring except in unfinished spaces.

D. Install cables without damaging conductors, shield, or jacket.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

B. Label each power monitoring and control module with a unique designation.

C. Label each cabinet with engraved laminated plastic nameplate with panel designation, power source, source location and voltage.

D. Label each meter with engraved laminated plastic nameplate with source panel and circuit designation), Maximo equipment identification number (EQ ID), and tenant space number, if applicable.

1. Maximo equipment identification number shall be provided by POS Aviation Maintenance. Serial number of meter is required to be submitted prior to issuance of EQ ID number.

3.6 GROUNDING

A. Comply with IEEE 1100, "Recommended Practice for Powering and Grounding Electronic Equipment."

B. Install equipment grounding connections to cabinets.

3.7 FIELD QUALITY CONTROL

A. Meters shall not be energized prior to inspection by Port Electric Shop. Schedule inspection through the Port Resident Engineer. Meter inspection shall take place at least three weeks prior to punch walk.

B. Contractor shall prepare for acceptance tests as follows:

1. Test insulation resistance for each component, connecting supply, feeder and control circuit.
2. Test continuity of each circuit and all ground connections. Megger with all circuit breakers open and then with all circuit breakers closed.
3. Verify continuity of equipment grounds and bonding jumper.
4. Verify correct phasing and orientation of CTs.

C. For large meter cabinet installations (more than four meters) provide the following:

1. Manufacturer's Field Service: Engage a factory-authorized service engineer to inspect components, assemblies, and equipment installations, including connections, pre-testing, testing, programming and commissioning.
   a. Meters shall be configured, programmed, tested and commissioned by a certified integrator with 5 years' experience on Port approved meters.
   b. Perform inspections and tests listed in NETA ATS and certify compliance with test parameters.
   c. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 sections.
   d. Complete installation and startup checks according to manufacturer's written instructions.
   e. Manufacturer's certification of proper installation is required.

D. For meter installations of single meters or cabinets containing four meters or fewer, provide the following:

1. Tests and Inspections:
   a. Electrical Tests: Use caution when testing devices containing solid-state components.
   b. Continuity tests of circuits.
   c. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.
      1) Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
      2) Test LANs according to requirements in Section 271500 "Communications Horizontal Cabling."
      3) System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
      4) Verify accuracy of graphic screens and icons.
      5) Metering Test: Load feeders, measure loads on feeder conductor with an rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.
      6) Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.

   Power monitoring and control equipment will be considered defective if it does not pass tests and inspections.

E. Field Test Reports (Contractor and Field Service Engineer): Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

F. Correct deficiencies and make necessary adjustments. Retest. Verify that specified requirements are met.

G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

H. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

I. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of cabinets. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.9 TRAINING

A. Train Port maintenance personnel to adjust, operate, and maintain systems. See Section 017900 "Demonstration and Training."

1. Train Port's metering and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide training for a minimum of three shifts, with ten persons per shift. Course materials are to be submitted 30 days prior to the training date for review with copies provided to all participants on the day of training.
2. Training Aid: Use approved final versions of software and maintenance manuals as training aids.

3.10 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 262713

Revision History:

9/15/20 – Extensive revision to meter product and installation requirements. The following subsections were revised:

1.2.B-O, 1.3, 2.1.A, 2.3.5.1, 2.4-7, 2.9, 2.11. 3.1, 3.5.D, 3.7.A, 3.7.F

3/1/21 – Added requirement for demo of old meters when replaced with new. Added requirement for jumper for glass meter replacement. Replaced PXM 2260 and PXM 2280 meter requirement with PXM 3000. The following subsections were revised:

1.2.H.3.a, 1.2.J.2, 1.2.O.2.b, 1.2.O.3.a