READ THIS FIRST

Notice to the Design Engineer, please refer to the Port of Seattle, Facilities and Infrastructure standards for reference before editing this specification.

This Project Spec Document may need additional modifications to suit your project. It is recommended that you proofread each section, paying attention to any “Notes” boxes such as this one--you should remove these “Notes” sections as you go. Also, do a search for all bracket characters “ [ ] “ as they are used to show you areas containing options or project specific details (you can use Microsoft Word’s Find feature {Ctrl-F} to jump to an open bracket “ [ “ character quickly). Again, these bracket characters should be removed.

It is important that every paragraph be numbered to allow for easy referencing. If you use the document’s built in styles and formatting your outline should be fine (turn on the formatting toolbar by going to View > Toolbars > Formatting). Most paragraphs will use the style “Numbered Material” and can be promoted (Shift) or demoted (Shift-Tab).

You should not have to manually enter extra spaces, carriage returns or outline characters such as A, B, C, or 1.01, 1.02; the formatting will do this for you. The entire document is 11 pt. Arial. If you paste items in, you may need to reapply the “Numbered Material” format.

1. GENERAL
   1. SUMMARY OF WORK
      1. The extent and location of “Electrical Power Metering” Work is shown in the Contract Documents. This section includes the components for power metering and monitoring.
      2. Electrical Power Metering shall be provided, including, but not limited to, the main and branch circuits of medium voltage switchgears, low voltage switchgears, switchboards, motor control centers, panelboards, and all electrical distribution equipment, monitoring all feeder and branch circuits without exception.
   2. GOVERNING CODES, STANDARDS AND REFERENCES
      1. ANSI C12.1: Electric Meters – Code for Electricity Metering
      2. ANSI C12.20: Electricity Meters – 0.1, 0.2, and 0.5 Accuracy Classes
      3. ANSI/IEEE C57.13: Standard Requirements for Instrument Transformers
      4. FCC Part 15
      5. NECA (National Electrical Contractors Association)
      6. NETA (InterNational Electrical Testing Association)
      7. NFPA 70: National Electrical Code (NEC)
      8. NFPA 70 E: Standard for Electrical Safety in the Workplace
      9. Underwriters Laboratories, Inc.
      10. UL 2808: Energy Monitoring Equipment
      11. UL 61010-1: Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use
      12. IEEE 802.3
   3. SUBMITTALS
      1. Submit materials data in accordance with Section 01 33 00 - Submittals. Furnish manufacturers’ technical literature, standard details, product specifications, calibration reports, and installation instructions for all products.
      2. Submittals shall include the following:
         1. Submit product data for the following:
            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, including communication protocols and datapoints; of the power monitoring equipment and cabinet components.

Shop Drawings and Seismic Qualification Certificates are for meters in separate enclosures. Remove 2 & 3 if project meters are incorporated into switchgear/panels.

* + - 1. 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.
      2. Seismic Qualification Certificates: Submit certification that meters, accessories, and components will withstand seismic forces defined in Section 26 05 48 - Structural Loading Controls for Electrical and Communication Work. 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.
      3. Field quality-control reports including results of On-Site Assistance activities.

Designer shall coordinate with Project Manager and Utility Analyst for Meter Installation and Removal form for Waterfront projects. For Aviation projects coordinate with F&I.

* + - 1. Meter Installation and Removal form.
      2. Operations and Maintenance Data: shall comply with requirements specified in Division 1, and include the following:
         1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.
      3. Firmware Operational Documentation:

Designer shall coordinate with Project Manager and ICT, and/or Aviation Maintenance on networking concerns.

* + - * 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. QUALITY ASSURANCE
     1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. WARRANTY
     1. The power metering instrument is warranted against manufacturing defects for a period of one year.
     2. Warranty service may be performed by the manufacturer or authorized service representative.
     3. Warranty 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 power metering instruments for the duration of the warranty period.
  3. DELIVERY, STORAGE AND HANDLING
     1. Deliver Power Metering system components in shipping splits in sizes that can be moved past obstructions in delivery path.
     2. Deliver Power Metering system components in fully enclosed vehicles after specific environmental conditions have been permanently established in spaces where components are to be placed.
     3. Store Power Metering 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.

Designer shall edit, or delete Coordination paragraphs below as project requirements.

* 1. COORDINATION
     1. 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.
     2. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

1. PRODUCTS

A. If only one product is acceptable (single or sole source product), obtain an approved Competition Waiver and submit to the CPO Construction, Contract Administrator. The language shall read as: “Manufacturer Name, Product # XXXXX, No Equal.” Refer to CPO-6 Competition Waiver Policy for more information.

B. If a Competition Waiver is not approved or more than one product is acceptable, this section must list a minimum of 2 products plus the language “Or Approved Equal,” along with salient characteristics. Refer to CPO Construction’s Salient Characteristics Guidelines for more information.

* 1. MANFACTURERS
     1. Electrical Meters:
        1. EATON, No Equal.
           1. Medium Voltage Unit Substations and Switchgear (5-15kV):

Main Breakers: PXQ 2

Feeder Breakers: PXQ 1

* + - * 1. Low Voltage Power Center and Switchgear (600V or less)

Main Breakers: PXQ 1

Feeder Breakers: PXQ 1

* + - * 1. Low Voltage Switchboards and Distribution Boards (600V or less)

Main breaker: PXQ1

Feeders shall be metered via multipoint meters PXMP or PXE 2 meters

* + - * 1. Low Voltage Panelboards (600V or less)

Main Breaker and Feeder Breakers:

PXMP

PXBCM-MB-ENERGY

PXBCM-MME

* + - * 1. Or manufacturer’s compatible which meets or exceeds where listed above is discontinued.
    1. Current Transformers and Sensors:
       1. ITI
       2. Eaton
       3. Or Approved Equal.
  1. SYSTEM REQUIREMENTS
     1. 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 26 43 13 - Surge Protective Devices 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.
     2. Addressable Devices: All transmitters and receivers shall communicate unique device identification and status reports to monitoring and control clients.
  2. POWER METERS
     1. PXQ 2
        1. Graphic Display Module
        2. I/O Card (8 Digital Inputs, 2 Solid State Outputs, 3 Relay Outputs)
        3. Communications Expansion Card with 10/100 Base-T, 100F, RS-485, RS-232 Ports
        4. Enhanced Expansion Module
     2. PXQ 1
        1. Graphic Display Module
        2. I/O Card (8 Digital Inputs, 2 Solid State Outputs, 3 Relay Outputs)
        3. Communications Expansion Card with 10/100 Base-T, 100F, RS-485, RS-232 Ports
     3. PXE 2

For Waterfront projects provide 7” enhanced meter display.

* + - 1. Graphical Display
      2. Communications Expansion with Dual RJ-45, BACnet/IP, EtherNet/IP, Modbus TCP/IP
  1. MULTI-POINT METERING

Multi-point Metering only for use on panelboards and switchboards.

* + 1. Panelboard/Switchboard shall be equipped with integral multi-point metering system for metering of all loads fed from the assembly. Multipoint Meter shall support:
       1. Where applicable:
          1. Install multi-point metering (MPM) in Switchboard and Panelboards at the factory.
          2. Install multi-point metering (MPM) in separate cabinet at the factory.

Section 26 27 16 – Cabinets and Enclosures

* + - 1. Pre-wire current sensors and interface modules to MPM.
      2. Pre-wire metering voltages and control power connections.
      3. Install HMI on hinged door.

Designer shall coordinate appropriate HMI with project requirements.

* + - * 1. Catalog # PXMP-DISP-6-TM-XV
        2. Catalog # PXMP-DISP-6-XV
        3. Or manufacturer’s compatible which meets or exceeds where listed above is discontinued.
    1. Requirements
    2. ANSI C12.20 0.5 or better accuracy class for sub-metering of loads with 125A, 250A and 400A solid core current sensors with voltage clamping circuits.
    3. 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.
    4. Communications Capabilities
       1. The MPM shall support Ethernet communications including MODBUS TCP, BACnet/IP, HTTPS, SFTP, SNMP, SMTP, and NTP.
       2. Catalog # PXMP-EPM
          1. Or manufacturer’s compatible which meets or exceeds where listed above is discontinued.
  1. BRANCH CIRCUIT MONITORING
     1. Power Xpert Branch Circuit Monitor (PXBCM)
        1. This system shall consist of meter base, and meter module(s) as described below.
        2. The Branch Circuit Monitor shall measure operational data for up to 84 branch load circuits.
        3. The Branch Circuit Monitoring shall have the following ratings
           1. 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] [4X] [12].
           2. See Section 26 27 16 – Cabinets and Enclosures.
        4. PXBCM-MB-ENERGY Meter Base
        5. PXBCM-MMS Meter Module Strip
        6. PXBCM-MME Meter Module External

For retrofit applications at the Airport. For other manufacturers at Waterfront.

* + - * 1. The PXBCM Meter Module external shall support 25 channels of current using external 333mV current sensors connected to terminal strips on the PXBCM-MME.
        2. Power and Energy metering shall be performed based on the voltage assignment for each 333mV current sensor input as configured using embedded WEB server.

Designer shall coordinate appropriate HMI with project requirements.

* + - * 1. Catalog # PXMP-DISP-6-TM-XV
        2. Catalog # PXMP-DISP-6-XV
        3. Or manufacturer’s compatible which meets or exceeds where listed above is discontinued.
      1. Eaton Gateway
         1. The gateway shall include internal memory capable of storing meter data.
         2. Catalog # PXG1000

Or manufacturer’s compatible which meets or exceeds where listed above is discontinued.

Select HMI Displays appropriate for project needs.

* 1. HMI (Human Machine Interface)
     1. For use with PXQ 1 and PXQ 2 meters:
        1. Catalog # PXDB-HMI-15
        2. Catalog # PXDB-HMI-21
        3. Or manufacturer’s compatible which meets or exceeds where listed above is discontinued.
     2. For use with PXE 2 meters:
        1. Catalog # PX-EMD-G
        2. Or manufacturer’s compatible which meets or exceeds where listed above is discontinued.
  2. CURRENT TRANSFORMERS
     1. Ratios as indicated; burdened and c-200 minimum accuracy class suitable for revenue grade meters.

Designer shall select appropriate core type(s) for project needs. Split core is recommended for retrofit only.

* + - 1. [Solid core type], [or split 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. All CTs shall be provided with 5A secondaries at the primary rated current.
      5. CT output shall be 0-5A proportional to the maximum full scale amperage rating.
      6. Accuracy shall satisfy revenue grade requirements of ANSI C12.20.
    1. For PX MPM Series and PX BCM Series Meters
       1. 5A secondaries for all circuits rated 2000A to 401A.
       2. 333mV output CTs for circuits rated up to 400A.
          1. Accuracy shall satisfy revenue grade requirements of ANSI C12.20.

1. INSTALLATION
   1. INSTALLATION
      1. Electrical power meters shall be installed per manufacturer's instructions and requirements to ensure performance of the meters according to Eaton.
      2. HMI Display shall display data for all configured meters.
         1. Displayed information shall include:

Meter name

Current

Voltage

Energy consumption

kWh

kW

kVARh

kVAR

kVA

Reverse kW

Reverse kVA

Demand

Average

Maximum

Power factor

Aggregated power and energy readings for any 1, 2, or 3 pole meters

* + 1. The Branch Circuit Monitor shall measure the following operational data:
       1. Forward and Reverse kWh

Watts, VA, Amps, Power Factor

Present and Peak demand readings for Amps, Forward and Reverse Watts

* + - 1. Maximum Watts, VA, Amps
         1. 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.

High, High-High, Low, Low-Low non-latching alarms for current.

High and Low latching alarms for current, resettable via Modbus or the WEB interface.

High and Low latching and non-latching voltage alarms for each meter module input voltage.

Alarm Status and alarm counters shall be available via Modbus communications.

* 1. IDENTIFICATION
     1. Identify components according to Section 26 05 53 - Electrical Identification.
     2. Label each power monitoring and control module with a unique designation.
  2. GROUNDING
     1. Comply with requirements in Section 26 05 26 - Grounding and Bonding for Electrical Systems.
     2. Comply with IEEE 1100, "Recommended Practice for Powering and Grounding Electronic Equipment."
  3. FIELD QUALITY CONTROL
     1. Testing Agency: Engage a qualified independent testing firm to perform field quality-control testing as specified in Section 26 08 00 - Acceptance Testing.
        1. Electrical Contractor shall accompany the independent testing firm field service technician and assist as required during field tests.
     2. Correct deficiencies and make necessary adjustments. Retest. Verify that specified requirements are met.
     3. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
     4. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.
     5. Remove and replace malfunctioning devices and circuits and retest as specified above.
     6. After acceptance of testing all meters shall be set to zero.
  4. CLEANING
     1. 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.
  5. TRAINING
     1. Train Port maintenance personnel to adjust, operate, and maintain systems. See Section 01 79 00 - 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.
  6. ON-SITE ASSISTANCE
     1. 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.

1. MEASUREMENT AND PAYMENT
   1. GENERAL
      1. No separate measurement or payment will be made for the Work required by this section. The cost for this portion of the Work will be considered incidental to and included in the payments made for the applicable bid items in the [Schedule of Unit Prices] [Lump Sum price bid for the Project].

End of Section

Revision History:  
02/15/2021 New Section  
12/01/2025 General revisions and updates