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PART 1 GENERAL

1.1 DESCRIPTION

A. Purpose

1. This section covers electrical service sub-meters for use on the UW Seattle campus, power distribution systems.

1.2 QUALIFICATIONS

A. Approved manufacturers

1. Electrical Sub-Meters

- a. Electro Industries – Shark 200 with V3 Switch Pack
- b. Electro Industries – Shark MP200 with V2 Switch Pack and optional Ethernet Modbus communications module.
- c. Eaton – PXMP with Local Display and Energy Portal Module (Ethernet Communications/ModbusTCP)
- d. Eaton – PXM2260
- e. GE – EPM 4600 with Basic Logging, Local Display and Ethernet Communications (ModbusTCP) options
- f. Siemens SEM3 Branch Circuit Meter, Local Display and Ethernet Communications (ModbusTCP) options

2. Test Blocks

- a. GE – PK-2 #644120G3 & PK-2 #6422420G4
- b. Marathon 1500
- c. Buss – 15149-3
- d. Or approved equal

1.3 RELATED SECTIONS

- A. 01 91 00 – General Commission Requirements
- B. 26 08 00.11 – Electrical Meter Integration and Commissioning

1.4 REFERENCES

A. Applicable codes, standards, and references codes, regulations and standards

1. National Electrical Testing Association – NETA
2. National Fire Protection Association – NFPA
3. National Electrical Code - NEC
4. ANSI C12.20 – Accuracy
5. ANSI/IEEE C37.90.1 – Surge Withstand
6. ANSI C62.41 – Surge Immunity
7. IEC 1000-4-2 – ESD
8. IEC 1000-4-3 – Radiated Immunity
9. IEC 1000-4-4 – Fast

Transient

10. IEC 1000-4-5 – Surge Immunity
11. IEC 1000-4-6 – Conducted Immunity
12. IEC 60068-2-6 – Vibration (Sinusoidal)
13. IEC 60068-2-27 – Shock Test
14. IEC 695-2-1 – Resistance to heat & Fire
15. IEC 68-2-1 – Cold Test
16. IEC 68-2-2 – Dry Heat
17. IEC 68-2-30 – Damp Heat
18. State and local codes and ordinances

B. Attachments and Details

1. Attachment #1 – Electrical Meter Schematic

1.5 COORDINATION

- A. Coordinate design of building electrical system, risers, switchboards, and panelboards in accordance with Attachment #1 – Electrical Meter Schematic with Campus Utilities and with Operations Power Systems Manager.
- B. Coordinate pre-installation meeting with Campus Utilities and Operations
- C. The project team shall complete the required fields on the “Early Building Services (EBS)” tab of the UW-IT Outlet Schedule. All fields listed under “Project Responsibility” on the EBS tab must be filled in.

- D. If a UW-IT Outlet Schedule is not being maintained for the project, the project team shall submit a FacNet IP Address Request by emailing uwfot@uw.edu with the subject line: "FacNet IP address request."

In the body of the email, provide the following information for each IP address being requested:

- Location: Room name and number
 - If using an existing biscuit jack, include the Outlet ID (label on the data outlet).
- Device Type: For example, Electrical Meter, CCW Meter, Data Collection
 - Controller, etc.
- IDF Room: IT service origination for data jack, if known.
- Panel Name: Device enclosure name or label.
- MAC Address: Format should follow standard convention (e.g.,
 - 00:05:e4:05:0D:d2).
- E. Device startup, commissioning, and integration into the Owner's data aggregation software shall be completed in accordance with the Startup, Commissioning, and Integration Specification (26 08 00.11 for Electrical or 23

08 00.11 for Mechanical).

- F. Coordinate Operations and Maintenance training times with the Campus Utilities and Operations.

1.6 SUBMITTALS

- A. Submittals shall only be approved by Campus Utilities and Operations (CEUO)
1. Submittals shall be in accordance with Conditions of the Contract and Division 01 Specification Sections.
 2. Submittals shall be complete and provide all necessary details for full review of products and shop drawings against project design documents. Incomplete or partial submittals will be rejected and not reviewed.
 3. Submit sub-metering plan to ensure code compliance. The metering plan shall detail how sub-metered values will account for all required load types and shall account for required percentage of total building load as required by code. Refer to Attachment #1 – Electrical Meter Schematic.
 4. Submit electrical sub-metering as a separate submittal
 5. Submit a completed "Worksheet: Mechanical Meter Schedule" form per Specification 23 08 00.11
 6. Submit detailed maintenance manuals and drawings, which include catalog information indicating the complete electrical and mechanical characteristics.
 7. Submit dimensioned cross-sectional drawings (manufacturer's data sheets are acceptable).
 8. Submit finished meter tests – Manufacturer's Certified Test Reports showing compliance with ANSI C12.20 accuracy tests
 9. The project team shall complete the required fields on the "Early Building Services (EBS)" tab of the UW-IT Outlet Schedule. All fields listed under "Project Responsibility" on the EBS tab must be filled in.
 10. If a UW-IT Outlet Schedule is not being maintained for the project, the project team shall submit a FacNet IP Address Request by emailing uwfot@uw.edu

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- MAC Address: Format should follow standard convention (e.g., 00:05:e4:05:0D:d2).
- 11. Device startup, commissioning, and integration into the Owner's data aggregation software shall be completed in accordance with the Startup, Commissioning, and Integration Specification (26 08 00.11 for Electrical or 23

08 00.11 for Mechanical).

1.7 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Operations and Maintenance Manuals shall be in accordance with Conditions of the Contract and Division 01 Specification Sections.
- B. Operations and Maintenance Manuals shall include catalog information indicating complete electrical and mechanical characteristics.
- C. Manufacturer's Certified Test Reports
- D. Manufacturer's drawings of meter wiring diagram.
- E. As-Built drawings of meter topology.

1.8 MEETINGS

- A. Pre-installation conference
 - 1. The Contractor shall request a pre-installation conference with the UW Campus Utilities and Operations.
 - 2. UW High Voltage Shop shall be included in pre-installation meeting for projects with medium and high voltage work.
 - 3. Attend meetings with the Owner and/or Owner's Representative as required to resolve any installation or functional problems.

PART 2 PRODUCTS

2.1 GENERAL

- A. These electrical meter specifications are in accord with the Owner's policy to construct permanent installations with long life, coupled with maximum reliability and safety.

2.2 ELECTRICAL SUB-METERS

- A. The following shall apply to single circuit meters:
 - 1. The meter shall be UL listed.
 - 2. Energy meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems.

- a. Meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
 - b. Surge withstand shall conform to IEEE C37.90.1 and ANSI C62.41 (6 kV)
 - c. The meter shall be user programmable for voltage range to any CT or PT ratio.
 - d. Meter shall have a burden of not more than 0.36VA per phase Max at 600V, 0.014VA at 120 Volts.
 - e. Meter shall have a burden of not more than 0.005VA per phase Max at 11 Amps.
 - f. The meter shall accept a voltage input range from 20 up to 576 Volts Line to Neutral, and a range from 0 up to 721 Volts Line to Line.
 - g. Meter shall accept a current reading of up to 10 Amps continuous. Start up current for a 5 Amp input shall be no greater than 0.005 Amps.
 - h. Meter shall come standard with one solid state KYZ pulse output for remote energy pulse counting.
3. Energy meters shall allow all wiring through the front of the unit, so that the unit can be surface-mounted.
 - a. Fault Current Withstand shall be 100 Amps for 10 seconds at 23°C.
 - b. All inputs and outputs shall be galvanically isolated and tested to 2500 Volts AC.
 - c. The meter shall accept current inputs of class 10: (0 to 10) A, 5 Amp Nominal, and class 2 (0 to 2) A Secondary, 1A Nominal.
4. The meter shall include a three-line, bright red, .56" LED display.
 - a. The meter must display a % of Load Bar on the front panel to provide an analog feel. The % Load bar shall have not less than 10 segments.
 - b. The sub-meter must have a programmable display, which allows for the following programming functions including automatic scroll, screen selection programming, and energy scaling.
5. Sub-meter shall be a traceable revenue sub-meter, which shall contain a utility grade test pulse, allowing power providers to verify and confirm that the sub-meter is performing to its rated accuracy.
6. The meter shall include communications ports with advanced features.
 - a. Port 1 shall provide an Optical (IrDA) port (through the faceplate) which shall allow the unit to be set up and programmed using a remote laptop without need for a communication cable. Meter programming via Ethernet interface is acceptable.
 - b. Port 3 shall be 10/100BaseT Ethernet. The meter shall provide an RJ45 Ethernet connection which shall allow the unit to be assigned an IP address and communicate Modbus TCP.
7. 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.

- a. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features. KWH, KVARH, and KVAH
 - b. All other parameters shall offer max and min capability over the user selectable averaging period.
 - c. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.
 - d. The Meter shall provide upgrade rate of 6 cycles for Watts, Var and VA. All other parameters shall be 60 cycles.
 8. The meter shall support power supply of 90 to 400 Volts AC and 100 to 370 Volts DC. Universal AC/DC Supply shall be available and shall have burden of 16VA Max.
 9. The meter shall provide Limits Alarms and Control Capability as follows:
 - a. Limits can be set for any measured parameter.
 - b. Up to 16 limits per parameter can be set.
 - c. Limits shall be based on % of Full Scale settings.
 10. The meter shall have 2 Megabytes data-logging capability. The meter shall have a real-time clock that allows for time stamping of all the data in the meter when log events are created. The meter shall have logs for the following:
 - a. The meter shall have historical logs for trending profiles.
 - b. The meter shall have a log for Limits Alarms. The Limits log shall provide magnitude and duration of an event, time-stamp, and log value. The log must be capable of recording to 2048 events.
 - c. 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, Programmable Settings Changes.
 11. The meter shall have a standard 4-year warranty.
 12. Energy meter shall be able to be stored in (-20 to +70) degrees C.
 - a. Operating temperature shall be (0 to +60) degrees C.
 - b. NEMA 12 faceplate rating shall be available for the energy meter.
 13. The following shall be supplied for each circuit the sub meter is to be connected to:
 - a. 4 pole voltage test switch, fuse block, and appropriately sized fuses
 - b. 6 pole current shorting block
 - c. Separate power supply for the meter.
 14. Multi-Point Sub Meters shall accommodate 8-3 phase 4 wire loads.
- B. The following shall apply to multi circuit meters:
1. The meter shall be UL listed.
 2. Energy meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems.
 - a. Meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4

- wire Delta systems.
 - b. Surge withstand shall conform to IEEE C37.90.1 and ANSI C62.41 (6 kV)
 - c. The meter shall be user programmable for voltage range to any CT or PT ratio.
 - d. Meter shall have a burden of not more than 0.36VA per phase Max at 600V, 0.014VA at 120 Volts.
 - e. Meter shall have a burden of not more than 0.005VA per phase Max at 11 Amps.
 - f. The meter shall accept a voltage input range from 20 up to 576 Volts Line to Neutral, and a range from 0 up to 721 Volts Line to Line.
 - g. Meter shall accept a current reading of up to 10 Amps continuous. Start up current for a 5 Amp input shall be no greater than 0.005 Amps.
 - h. Meter shall come standard with one solid state KYZ pulse output for remote energy pulse counting.
3. Energy meter shall allow all wiring through the front of the unit, so that the unit can be surface-mounted.
 - a. Fault Current Withstand shall be 100 Amps for 10 seconds at 23°C.
 - b. All inputs and outputs shall be galvanically isolated and tested to 2500 Volts AC.
 - c. The meter shall accept current inputs of class 10: (0 to 10) A, 5 Amp Nominal, and class 2 (0 to 2) A Secondary, 1A Nominal.
 4. The meter shall include a panel mount display that can be configured to show accumulated meter information as well as each individual sub-meter.
 5. Sub-meter shall be a traceable revenue sub-meter, which shall contain a utility grade test pulse, allowing power providers to verify and confirm that the sub-meter is performing to its rated accuracy.
 6. The meter shall include communications ports with advanced features.
 - a. Port 3 shall be 10/100BaseT Ethernet. The meter shall provide an RJ45 Ethernet connection which shall allow the unit to be assigned an IP address and communicate Modbus TCP.
 7. 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.
 - a. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features. KWH, KVARH, and KVAH
 - b. All other parameters shall offer max and min capability over the user selectable averaging period.
 - c. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.
 - d. The Meter shall provide upgrade rate of 6 cycles for Watts, Var and VA. All other parameters shall be 60 cycles.
 8. The meter shall support power supply of 90 to 400 Volts AC and 100 to 370 Volts DC. Universal AC/DC Supply shall be available and shall have burden

of 16VA Max.

9. The meter shall provide Limits Alarms and Control Capability as follows:
 - a. Limits can be set for any measured parameter.
 - b. Up to 16 limits per parameter can be set.
 - c. Limits shall be based on % of Full Scale settings.
10. The meter shall have 2 Megabytes data-logging capability. The meter shall have a real-time clock that allows for time stamping of all the data in the meter when log events are created. The meter shall have the following logs at a minimum:
 - a. The meter shall have historical logs for trending profiles. Each log shall be capable of being programmed with up to 64 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 the logs.
 - b. The meter shall have a log for Limits Alarms. The Limits log shall provide magnitude and duration of an event, time-stamp, and log value. The log must be capable of recording to 2048 events.
 - c. 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, Programmable Settings Changes.
11. The meter shall have a standard 4-year warranty.
12. Energy meter shall be able to be stored in (-20 to +70) degrees C.
 - a. Operating temperature shall be (0 to +60) degrees C.
 - b. NEMA 12 faceplate rating shall be available for the energy meter.
13. The following shall be supplied for each circuit the sub meter is to be connected to:
 - a. 4 pole voltage test switch, fuse block, and appropriately sized fuses
 - b. 6 pole current shorting block
 - c. Separate power supply for the meter.
14. Multi-Point Sub Meters shall accommodate 8-3 phase 4 wire loads.

PART 3 EXECUTION

3.1 REQUIREMENTS

A. General installation

1. Identification and Labeling
 - a. Reference section 26 05 53 Identification of Electrical Equipment
 - b. All wiring and devices shall be properly labeled in accordance with system diagrams and wiring details to identify device tag, name, and purpose.
 - c. Wire labels shall be machine made shrink type labels and match wire designations on the instrumentation drawings.
 - d. Field devices including electrical meters shall be labeled with Brother P-touch or equal.
 - e. Label in accordance with other sections of this specification.

2. Installation

- a. Only personnel qualified and experienced in this type of work shall make connections.
- b. The installation of meters shall be done with care to avoid damage.
 - 1) Meters showing damage after installation shall be replaced.
 - 2) Metering cabinets hung improperly shall be properly secured and all paint scratches shall be touched up.
- c. Each device requiring communication on the FacNet network shall be provided with a dedicated Category 6 (CAT6) communication cable. The cable shall be installed in a minimum 1" rigid conduit and terminated at a FacNet data jack in accordance with UW-IT Specification Drawing OL-CI-2. The data jack shall be housed inside the following Milbank enclosure components:
 - 1) Milbank #12126-LC1 (12" x 12" x 6" enclosure)
 - 2) Milbank #A-LKSFMKEYL (hinged cover with lock)
 - 3) Key: #2233

Refer to UW-IT Specification Drawing CNT-CI-2: [CNT-CI-2 Drawing](#)

- d. The Milbank enclosure shall be mounted in a serviceable area within 10' of the device that will be communicating on the FacNet network. Any exceptions must be reviewed and approved by the Owner.
 - e. The Milbank enclosure shall be mounted at an accessible height (4'-5') above the finished floor. Exceptions must be reviewed and approved by the Owner.
 - f. A durable label (Brother P-touch or equal) shall be affixed to the exterior of the enclosure cover, indicating the IT Room from which service originates.
 - g. Where shared use of a FacNet data jack is proposed (e.g., electrical meter and lighting control device sharing a connection), the Contractor shall coordinate with the Owner and obtain approval prior to installation.
3. Meters shall be installed such that the display can be easily read and accessible. Meter display shall be mounted at an easily read height (4'-5') above finished floor (AFF). A shield shall be installed if display is installed in direct sunlight.
4. System Phase Sequence is A-B-C.
5. UW Campus Utilities and Operations or UW Campus Utilities and Operations Representative will check the Contractor's work to ensure the accuracy of the connections.
- a. The Contractor shall arrange with the Campus Utilities and Operations for the times when their services will be required, and under no circumstances shall the Contractor connect to the existing system without Owner's knowledge.
 - b. The proper connection of the wires and cables to other systems as specified is entirely the responsibility of the Contractor.
 - c. In the event the connections cannot be made as specified, the Contractor shall make the necessary corrections at Contractor's own expense.
6. Each device requiring communication on the FacNet network shall be

provided with a dedicated Category 6 (CAT6) communication cable. The cable shall be installed in a minimum 1" rigid conduit and terminated at a FacNet data jack in accordance with UW-IT Specification Drawing OL- CI-2. The data jack shall be housed inside the following Milbank enclosure components:

- a. Milbank #12126-LC1 (12" x 12" x 6" enclosure)
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 - 10. Where shared use of a FacNet data jack is proposed (e.g., electrical meter and lighting control device sharing a connection), the Contractor shall coordinate with the Owner and obtain approval prior to installation.
- B. Mounting and electrical connections
- 1. In accordance with manufacturer's installation instructions.
 - 2. Install a dedicated 120V circuit from panelboard to provide power to the electrical meter in a dedicated RGC/IMC. (if required)
- C. UL Listing
- 1. The Contractor shall ensure that the metering installation is UL Listed.
- D. The project team shall complete the required fields on the "Early Building Services (EBS)" tab of the UW-IT Outlet Schedule. All fields listed under "Project Responsibility" on the EBS tab must be filled in.

- E. If a UW-IT Outlet Schedule is not being maintained for the project, the project team shall submit a FacNet IP Address Request by emailing uwfot@uw.edu with the subject line: "FacNet IP address request."

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- F. Device startup, commissioning, and integration into the Owner's data aggregation software shall be completed in accordance with the Startup, Commissioning, and Integration Specification (26 08 00.11 for Electrical or 23

08 00.11 for Mechanical).

END OF SECTION