Electrical – Standard Specifications

ELECTRICAL – METER

STANDARD SPECIFICATIONS

This standard specification is intended to be integrated into the project specifications. The Consultant shall write the specifications to meet the project needs in consultation with the Owner and in accordance with the attached design information section.

PART 1 – GENERAL

1.01 DESCRIPTION

A. Purpose
1. This section covers electrical service meters and sub-meters for use in the Owner's power distribution systems.

1.02 QUALIFICATIONS

A. Approved manufacturers

1. Electrical Service Meters

a. Electro Industries – Nexus 1262
b. Electro Industries – Shark 270 with V3 Switch Pack
c. No Substitutions Allowed

2. Electrical Sub-Meters

a. Electro Industries – Shark 200 with V3 Switch Pack
b. Electro Industries – Shark MP200 with V2 Switch Pack
c. Eaton – PXMP Very features to make equal to Shark
d. Eaton – PXM2260
e. GE – EPM 4600 with Basic Logging

3. Test Blocks

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

1.03 RELATED SECTIONS

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

1.04 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

1.05 COORDINATION

A. Coordinate Operations and Maintenance training times with the Owner.

1.06 SUBMITTALS

A. General

1. Submittals shall be in accordance with Conditions of the Contract and Division 01 Specification Sections.
2. Submit detailed maintenance manuals and drawings, which include catalog information indicating the complete electrical and mechanical characteristics.
3. Submit dimensioned cross-sectional drawings (manufacturer's data sheets are acceptable).
4. Submit finished meter tests – Manufacturer's Certified Test Reports showing compliance with ANSI C12.20 accuracy tests

1.07 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.

1.08 MEETINGS

A. Pre-installation conference

1. The Contractor shall request a pre-installation conference with the UW Engineering Services and UW Physical Plant High Voltage Shop for projects with medium and high voltage work.

B. Attend meetings with the Owner and/or Owner's Representative as required to resolve any installation or functional problems.

PART 2 – PRODUCTS

2.01 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.

2.02 ELECTRIC SERVICE METER

A. The following shall apply to the main electric meters at the main building service:
1. Power meter shall be multi-function 3 phase, solid-state, socket-mount design.
a. Meter shall be capable of connection to three-phase, four-wire or three-phase, three-wire circuits.
b. Meter shall support meter form factors 9S, 36S, and 45S.

Form	Rated Voltage	Type
9S	0 to 277 V L-N	3E, 4W, Wye
36S	0 to 277 V L-N	2 ½ E, 4W, Wye with Neutral
45S	0 to 480 V L-L	2E, 3W, Delta

2. Voltage and current inputs to the meter shall conform to the following at a minimum:

a. Meter shall be a Class 20, transformer rated design.
b. Monitor shall accept input of three (3) independent voltage inputs and three (3) independent current inputs of the stated capacity.
c. Voltage inputs shall be rated for connection to circuits from 0 to 480 Volts AC line-to-neutral or 0 to 600 Volts AC line-to-line and shall be auto-ranging over this range.
d. Voltage input shall be optically isolated to 2500 volts AC. Shall meet or exceed IEEE 37.90.1 (Surge Withstand Capability). Communication ports shall be isolated from each other to 1000 Volts.
e. Current inputs shall have a continuous rating of 120% of Class Current and a 1-second over-current rating of 500 %.

3. Power meter shall measure and report the following quantities at a minimum:

a. Voltage, both phase to neutral and phase to phase, for all three phases; Phase angles for each voltage relative to each other.
b. Current, phase A, B, C, and N-calculated; Phase angles for each current relative to voltages.
c. Watts (total and per phase), VARs (total and per phase), VA (total and per phase), Power Factor (total and per phase) and Frequency.
d. Accumulated Watt-hr., VA-hr., and VAR-hr.; Watt-hr. received; Watt-hr. delivered. VAR-hr. and VA-hr. reading shall be accumulated and stored for each of the 4 quadrants of power.
e. Power demand shall be simultaneously calculated using five (5) different averaging methods: Fixed Window (Block) Average, Sliding Window (Rolling Block) Average, Thermal Average, Predicted Average, and Cumulative Demand.
f. Power meter shall provide time-stamped maximum and minimum readings for every measured parameter, and provide coincident VAR readings for all maximum Watt readings with time/date stamp.

4. The power meter shall compensate for errors in current transformer and potential transformer.

a. Errors shall include voltage, multipoint current, multiphase angle, and better than .01% resolution.

5. Meter shall include an integrated LCD display with multiple display modes. The display shall be fully customizable by the user.

a. Display shall at least support simultaneous Normal, Test, Diagnostic, and Time-of-Use modes.
b. Normal Mode shall have fully customizable screens.
c. Test Mode shall provide access to Wh (delivered and received), VARh (delivered and received), VAh (delivered and received), and instantaneous demand. When operating in test mode the stored readings from Normal Mode shall not be impacted or compromised.
d. Diagnostic Mode shall provide access to all voltages and currents, a real-time phasor diagram, and real-time harmonics of each voltage and current to the 40th order.

Viewing harmonics to the 128th order shall be available through a connected computer.

e. Time of Use mode shall provide access to kWh and kW for each TOU register and total, kVARh and kVAR for each TOU register and total and kVAh for each TOU register and total.

6. Power meter shall provide multiple digital communication ports and support multiple open protocols.

   a. Meter shall include an IR port for communication to external devices such as handheld readers that supports speeds of up to 57,600 bps.
   b. Meter shall include a RS-485 digital communication ports. The port shall be user configurable with regard to speed, protocol, and address.
   c. Meter shall have a second port configured as a 10/100BaseT Ethernet port.
   d. Meter shall communicate using Modbus RTU, Modbus ASCII, and Modbus TCP/IP protocols as standard configurations. All instantaneous data, logged data, and event data, information shall be available using these open protocols. The meter shall also provide means for custom modbus mapping.
   e. Meter shall include DNP 3.0 Level 2 protocol for communication to SCADA systems. All instantaneous data and average data shall be available using DNP 3.0 Level 2 protocol. User shall be able to custom map data into DNP protocol using Windows based software.

7. The meter shall internally record and store Time of Use data.

   a. The following Time of Use parameters must be included:

      i. Bi-directional consumption and demand
      ii. Eight (8) TOU Schedules
      iii. Twenty (20) Year Calendar
      iv. Four (4) seasons per year.

   b. The meter must provide the following TOU information for all rates in real-time:

      i. Current month accumulations
      ii. Previous month accumulations
      iii. Current season accumulations
      iv. Previous season accumulations
      v. Total accumulations to date
      vi. Programmable Freeze Registers
      vii. Cumulative Demand

8. Meter shall be equipped with four (4) form C pulse output channels that can be configured for operation as KYZ pulse outputs or End of Interval pulse outputs.
9. Meter shall be equipped with eight (8) pulse input channels for data collection from other meters.
10. Power meter shall be equipped with non-volatile RAM for recording logs and programming information.

a. Meter shall include at least 512K RAM.
b. In the event of loss of control power, data stored in memory shall be retained for at least 10 years.
c. Meter shall store all programming and set-up parameters in non-volatile memory. In the event of loss of control power, meter programming data stored in memory shall be retained for at least 10 years. No replaceable battery shall be required.

11. Meter shall record system events for security and anti-tampering.
    a. Events recorded shall include:
        i. Power up & down
        ii. Password access & modification
        iii. Change of the programmable settings & run time
        iv. Change of clock time by communication (Modbus or DNP)
        v. Test Mode usage
        vi. Meter resets (Logs, Max/Min, Energy)
12. Power meter shall be programmable by software supplied by the meter manufacturer.
    a. Software shall have a user-friendly, Windows compatible interface.
    b. Software shall operate on Windows 2000, XP, Windows 2003, VISTA, or Windows 7 operating systems.
    c. Software shall include capacity to program meter, download meter, and analyze downloaded data files.
    d. Software shall store all data in an ODBC compliant database. Data based storage shall include all log and waveform data.
13. Power meter shall be appropriately constructed to provide long life in abusive physical and electrical environments.
    a. Meter firmware shall be held in flash RAM and shall be upgradeable through one of the communications port without removing the unit from service.
    b. Meter shall have a Lexan cover. An internal cover shall protect circuit boards and energized parts from UV damage or when the Lexan cover is removed for maintenance.
    c. Meter shall operate successfully at temperature extremes from –40o C to +85o C.
    d. Meter shall operate with control power from 85 to 550 volts AC. Meter shall have a power supply option to operate with an external control power input of 85 to 275 Volts AC/DC.
    e. Meter shall have a standard 4-year warranty.

2.03 ELECTRIC METERING CABINET

A. A socket based electrical cabinet shall be supplied with the electric service meters.
    1. The metering cabinet shall be an UL Type 1 or an UL Type 3R steel enclosure with factory supplied knock-outs.
    2. The metering cabinet shall have a minimum dimension of 18” x 18” x 12”.

3. The metering cabinet shall be provided in multiple configurations to support meter forms 9S, 36S, and 45S.
4. The cabinet shall be lockable and provide for the application of a security seal.
5. The cabinet shall be provided with a 4 pole potential test block, a voltage fuse block, and appropriately sized fuses that are prewired to the socket base.
6. The cabinet shall be provided with a 6 pole current shorting test block prewired to the socket base.
7. Metering cabinet shall be painted ANSI Z55.1 gray finish.

2.04 ELECTRICAL SUB-METERS

A. The following shall apply to single or 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. Startup 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 23oC.
    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.
    b. Port 2 shall be RS485. The meter shall speak Modbus RTU or ASCII protocol up to 57.6K baud.
    c. 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 protocol over Ethernet TCP/IP.
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.
    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 five logs:
    a. The meter shall have three 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 three 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 timestamp: Demand Resets, Password Requests, System Startup, Energy Resets, Log Resets, Log Reads, and 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

3.01 REQUIREMENTS

A. General installation

1. Identification
    a. Reference section 26 05 53 Identification
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.
        i. Meters showing damage after installation shall be replaced.
        ii. Metering cabinets hung improperly shall be properly secured and all paint scratches shall be touched up.
    c. Each meter shall have dedicated CAT5E communication cable installed to connect the meter to the facility network.
    d. Meters shall be installed such that the display is no higher than 72” above the floor.
3. System Phase Sequence is C-B-A.
4. UW’s Physical Plant Department High Voltage Shop will check the Contractor's work to ensure the accuracy of the connections.
    a. The Contractor shall arrange with the Owner 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 his own expense.
5. Install meters per manufacturer's recommendations.

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. Integration and Commissioning

1. See Electrical Meter and SCADA Integration and Commissioning