SECTION 25 01 00
UTILITY METERING AND MONITORING
Construction Specifications

PART 1 GENERAL

1.1 SUMMARY

A. All new buildings and some completely retrofitted buildings, as defined by the District, shall incorporate metering into their design for the monitoring of the utility usage for the building. As a minimum, this shall include the main point of entry for power demand (kW), electrical consumption (kWh), water and gas.

B. The meters installed in this project will be connected to the campus-wide Facility Management System (FMS) that utilizes a dashboard interconnecting all existing and new meters. Other systems may use the same meters for other purposes as deemed appropriate by the District.

C. All meters shall be connected to the FMS or other systems requiring the data from the meters installed. Any meter shall either be and IP meter or shall be serially connected to an appliance feeding the data to an IP access point capable to provide all points available at the meter, including points not listed in the specification.

D. It is the intent that all building will receive at least one building level meter for gas and water. For power metering T24/2016, or superseding CA Title 24 requirement, shall be the minimum requirement. For structures not requiring T24 compliance, provide one meter for each applicable utility at the feed to the structure.

1.2 RELATED DOCUMENTS

A. Division 22 Section 220800 "Plumbing Commissioning Requirements" for commissioning process activities for building systems, assemblies, equipment, and components.

B. Division 23 Section 230800 "HVAC Commissioning Requirements" for commissioning process activities for building systems, assemblies, equipment, and components.

C. Division 26 Section 260800 "Electrical Commissioning Requirements" for commissioning process activities for building systems, assemblies, equipment, and components.

D. Division 25 Section 255500 "Facility Management Systems" for commissioning process activities.

1.3 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

B. Btu: British Thermal Units

C. Scfm: Standard cubic feet per minute (Gas)

D. Ton: Measure of energy 12,000Btu

1.4 SUBMITTALS

A. During the product submittal phase, provide a full submittal of the product specifications, product selection justifications and how the product will integrate into the FMS, Analytic systems and dashboards. The submittal shall be specific enough for the review to understand exactly what type of information will be provided and how the information is delivered form the point of metering to the point of data storage.

B. Provide all test methods used to verify correct installation for all meter types for review and approval.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. Include the following

1. Application and operating software documentation.
2. Software licenses.
3. Software service agreement.
4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

PART 2 PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING

A. Manufacturers: Subject to compliance with the basis of design, provide products by one of the following:

1. Energy (BTU) Measurement System: Onicon System 10
2. Gas Flow Meter: Onicon F-5100, or approved equal Quadratherm 780
3. Water Flow Meter: Onicon F-3100
4. The power meter “PM5xxx series, three phase AC power meter” manufactured by Schneider Electric or equivalent. The building point of entry shall meter shall have power quality capability. All meters shall have the ability to show phasor diagrams, locally or with a separate diagnostics tool.
5. Electro Industries Shark 200 series and required I/O cards are equivalent meters to PM5xxx
6. Schneider Multi-circuit meters can be used if multiple measurement in the same sub distribution panel are taken. Do not use Multi-circuit meters for the building Main Point of Entry.

B. Compliance with Standards

1. Power meter device shall be compliant with the standards listed below:

Accuracy

Standard	Title	Usage
IEC 62053-22	Part 22: Static meters for active energy (classes 0,2 S and 0,5 S)	
IEC 62053-23	Part 24: Static meters for reactive energy (classes 0,5 S, 1S and 1)	IEC 62053-24 not yet released at the time of development.
ANSI C12.20	Active energy accuracy	Tests 2 – 9, 11, 13, 14

Electromagnetic compatibility

Standard	Title	Usage
IEC 61000-4-2	Electrostatic discharge	
IEC 61000-4-3	Immunity to radiated fields 80 MHz to 2 GHz current of in applied	
	Immunity to radiated fields 80 MHz to 2 GHz currents open circuit	
	Immunity to radiated fields 2 GHz to 2.7 GHz currents open circuit	
IEC 61000-4-4	Immunity to fast transients voltage and current inputs	
	Immunity to fast transients aux. circuits >40V	
IEC 61000-4-5	Immunity to impulse waves DM: voltage/current/power supply Level 4 DM: aux. circuits>40V level 2 CM: Power supply line and neutral level 3	
IEC 61000-4-6	Conducted immunity 150kHz to 80MHz – Level 3	
IEC 61000-4-8	Immunity to magnetic fields – Level 4	

IEC 61000-4-11	Immunity to voltage dips – class 1	
FCC part 15, EN 55011	Radiated emissions & conducted emissions class B	

Safety

Standard	Title	Usage
IEC 61010-1 Ed. 3 & IEC 62052-11		CE marking
UL61010-1 (3rd edition)		cULus, UL marking
Overvoltage category		CAT III up to 400V L-N / 690V L-L nominal per IEC 61010-1 CAT III up to 347V L-N / 600V L-L nominal per UL 61010-1

A. Power Meter Design

General provisions & common features

1. All setup parameters required by the power meter shall be stored in nonvolatile memory and retained in the event of a control power interruption.
2. The power meter may be applied in single phase, three-phase, three- or four-wire systems in WYE or Delta mode.
3. The power meter shall be capable of being applied without modification at nominal frequencies of 50 or 60Hz.
4. The power meter shall have a real-time clock with battery back-up with at least 1 year ride-through time without external power.

B. Mechanical

1. The power meter unit shall have removable connectors for voltage inputs, control power, communications, input and outputs.
2. The power meter unit shall be easily mounted in the pre-made cut-out without tools.
3. Power meter form factor shall be ¼ DIN with 92 x 92 mm (3.622” x 3.622”) cut-out and 96 x 96 mm (3.78” x 3.78”) panel mount integrated display.

C. Sampling and harmonic resolution

1. The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 31st harmonic (fundamental of 50/ 60 Hz). The power meter shall provide continuous sampling at a minimum of up to 64 samples/cycle, simultaneously on all voltage and current channels in the meter.
2. The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 63rd harmonic (fundamental of 60 Hz). The circuit monitor shall provide continuous sampling at a minimum of up to 128 samples/cycle, simultaneously on all voltage and current channels in the meter.

D. Current inputs

1. 0-10 amps with 5 amps nominal input from CT secondary.
2. The power meter may be applied in three-phase, three- or four-wire systems.
3. Residual current shall be calculated by vectorial addition of the phase currents.
4. A fourth CT input shall be available to measure neutral or ground current.

E. Voltage inputs

1. Nominal of 400 V L-N / 690 V L-L.

2. Maximum of 480 V L-N / 828 V L-L.

F. Control power (device)

PART 1 The monitoring device control power shall be:
a. 100-415 VAC L-N ±10% or 125-250 ± 20% VDC
b. 110-480 ±10%, VAC or 125-250 ± 20% VDC
PART 2 Environmental characteristics
a. Operating temperature range for meter: -25 to 70 °C (-13 to 158 °F)
b. Operating temperature range for display: -20 to 70 °C (-4 to 158 °F)

2.2 BTU METERS

A. The entire Energy Measurement System shall be built and calibrated by a single manufacturer, Onicon Incorporated, and shall consist of a flow meter, two temperature sensors, a BTU meter, temperature thermowells, and all required mechanical installation hardware. A certificate of U.S. National Institute of Standards and Technology (NIST) traceable calibration shall be provided with each system. All equipment shall be covered by the manufacturer's two year warranty.

B. BTU Meter: Provide an ONICON System-10 BTU Meter. The BTU meter shall provide the following points both at the integral LCD and as outputs to the building control system: Energy Total, Energy Rate, Flow Rate, Supply Temperature and Return Temperature. Output signals shall be either serial network (protocol conforming to BACnet) and/or via individual analog and pulse outputs. Each BTU meter shall be factory programmed for its specific application, and shall be re-programmable using the front panel keypad (no special interface device or computer required).

C. Temperature sensors: Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST traceable) for the specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within $\pm$0.15°F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).

D. Flow Meter: The flow meter shall be installed either in the supply or return pipe of the system to be measured following the manufacturer's instructions with particular attention paid to upstream and downstream straight pipe runs. Insertion type flow meters shall be provided with all installation hardware necessary to enable insertion and removal of the meter without system shutdown and shall be hand insertable up to 400 psi. For installations in non-metallic pipe, install grounding rings or probes as required.

1. New Construction: Insertion Type flow meters are allowed only for pipe sizes > 6". 6" or smaller pipes shall be fitted with in-line type flow meters. Follow all applicable manufactures guidelines for up and downstream clearances. If the required clearances cannot be achieved for the insertion type meter use the in-line meter.
2. Retrofit: Insertion Type flow meters are allowed as long as the manufacturer guidelines for up and downstream clearances. If the required clearances cannot be achieved for the insertion type meter use the in-line meter.

E. Insertion Electromagnetic Type: Provide an ONICON Model F-3500 Insertion Electromagnetic Flow Meter. Materials of construction for wetted metal components shall be 316 SS. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within ± 0.8% of rate from 1-33 ft/s. Overall turndown shall exceed 100:1. Output signals shall be completely isolated and shall consist of the following: (1) high resolution frequency output for use with peripheral devices

such as an ONICON display module or Btu meter, (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable and (1) scalable dry contact output for totalization. Each flow meter shall be covered by the manufacturer's two-year warranty. Use grounding rings if installed in none metallic pipes.

F. In-line Type: Provide an ONICON Model F-3100 In-line Electromagnetic Flow Meter. Materials of construction for wetted metal components shall be 316 SS. The flow meter shall average velocity readings from two sets of diametrically opposed electrodes. Each flow meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within ± 1% of rate from 2-20 ft/s. Overall turndown shall exceed 100:1. Output signals shall be completely isolated and shall consist of the following: (1) high resolution frequency output for use with peripheral devices such as an ONICON display module or Btu meter, (1) analog output; 4-20mA, 0-10V, or 0-5V jumper selectable and (1) scalable dry contact output for totalization. Each flow meter shall be covered by the manufacturer's two-year warranty.

2.3 GAS FLOW METERS

A. Provide an ONICON Model F-5100 Insertion Thermal Mass Flow Meter, complete with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand-insertable up to 250 psi. Provide a flow conditioner if required to meet the manufacturer's minimum upstream straight pipe run requirement. For pipe sizes smaller than 1½" provide an Onicon Model F-5100 Inline Thermal Mass Flow Meter. Materials of construction for wetted metal components shall be 316 SS. The flow meter shall provide SFPM flow readings from a pair of encapsulated platinum sensors and shall not require additional temperature or pressure compensation. In addition, the meter shall continuously display information that can be used to validate the calibration of the meter. Each flow meter shall be individually wet-calibrated against a standard that is directly traceable to NIST. A certificate of calibration shall be provided with each flow meter. Accuracy shall be within ± 1% of rate +0.5% of scale over a 100:1 turndown. Overall turndown shall exceed 1000:1. Output signals shall consist of the following: (1) analog 4-20mA output and (1) scalable pulse output for totalization. The meter shall be equipped with an integrally mounted graphical display that may be optionally remote mounted up to 1000 ft from the sensor. Each flow meter shall be covered by the manufacturer's two-year warranty.

B. Where indicated on the drawings, provide a D-100 Series Display Module for remote indication of flow rate and total. Output signals shall be either serial network (protocol conforming to BACnet) or via individual analog and pulse outputs.

2.4 DOMESTIC OR INDUSTIRAL WATER FLOW METERS

A. Use the same flow meter as specified for Btu metering with the same selection criteria

B. Where needed, provide a D-100 Series Display Module for remote indication of flow rate and total. Output signals shall be either serial network (protocol conforming to BACnet) or via individual analog and pulse outputs.

2.5 TERMOMETER WELLS

A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.

1. Material: Brass, for use in copper piping.
2. Material: Stainless steel, for use in steel piping.
3. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
4. Insertion Length: To extend to center of pipe.
5. Cap: Threaded, with chain permanently fastened to socket.
6. Heat-Transfer Fluid: Oil or graphite.

2.6 PIPE INSTALLATION KITS

A. Use manufacturer provided Hot Tap kits for all insertion type meters

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install power meters. Install raceways and equipment according to manufacturer's written requirements. Provide empty conduits for metering leads and extend grounding connections as required.

C. Install meters, gauges, and accessories according to manufacturer's written instructions for applications where used.

D. Meters installed in horizontal pipe shall be installed in the top half of the pipe when in-sufficient space is available for installation in the preferable location in the top of the pipe.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260503 "Identification for Electrical Systems."
   1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
   2. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

3.3 POINT MAPPING TO THE FMS AND OTHER SYSTEM

A. Power Meters provide the following data for each meter to the FMS, coordinate with Section 25 55 00 about communication requirements:
   1. Total Kw
   2. Total kWh
   3. Current Phases A
   4. Current Phases B
   5. Current Phases C
   6. Voltage Phase A
   7. Voltage Phase B
   8. Voltage Phase C
   9. Power Factor
   10. THD

B. Btu Meters provide the following data for each meter to the FMS, coordinate with Section 25 55 00 about communication requirements:
   1. kBtu or Ton
   2. kBtu/h or Ton/h (Htg/Clg)

3. Supply Temperature
4. Return Temperature
5. Flow in gal

C. Water Flow meters provide the following data for each meter to the FMS, coordinate with Section 25 55 00 about communication requirements:
1. gal
2. gal/h

D. Gas Flow meters provide the following data for each meter to the FMS, coordinate with Section 25 55 00 about communication requirements:
1. Scfm: Standard cubic feet per minute
2. scf : Standard cubic feet

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections Power Meters:
1. Verify the CT Ratio and compare it to the scheduled CT Ratio, document the actual CT ratios during install based on the CT installed for each meter.
2. Verify the reader is totalizing positive values
3. In occupied buildings, totalize the load for a one week span and compare the totalized readings to a comparable building type Education buildings typical consumption are 8-10 kWh/sf/year. Normalize for outside air conditions.
4. In unoccupied buildings, use a 2kw resistive type load, disconnect all other loads for one hour and read the totalized value before and after. The result should be 2kWh +/- 5%.
5. After the meter has been commissioned and configured by a qualified individual, use the phasor diagram to ensure all phases are connected in line. Provide the printout of the to the CP provider.

C. Tests and Inspections Btu Meters:
1. Verify the meter is installed per manufactures specifications, especially but not limited observing all required distances. Note all up and downstream distances observed in the installation documents for the meter.
2. Verify the reader is totalizing positive values
3. Use a strap on ultrasound meter with an accuracy of 1% and compare the flow rates during design flow conditions. Results should be within 5% of readings
4. Use a calibrated temperature probe at a P/T plug close to the supply and return sensors and compare the readings with the readings on the Btu meter. The readings should be within 2% of reading or 1 Deg whichever is better. If no P/T plug is available, use another method to obtain the fluid temperature data. Do not filed calibrate the Btu meters.

D. Tests and Inspections Water Meters:
1. Verify the meter is installed per manufactures specifications, especially but not limited observing all required distances. Note all up and downstream distances observed in the installation documents for the meter.
2. Verify the reader is totalizing positive values
3. Use a strap on ultrasounds meter with an accuracy of 1% and compare the flow rates during design flow conditions. Results should be within 5% of readings

E. Tests and Inspections Gas Meters:
   1. Verify the meter is installed per manufactures specifications, especially but not limited observing all required distances. Note all up and downstream distances observed in the installation documents for the meter.
   2. Verify the reader is totalizing positive values
   3. Use the connected load to calculate the total btu delivered and compare it to load connected under controlled conditions and calculate the resulting use over period of on hour. The result should be within 10% of reading. Use the manufacturer stated efficiency to account for losses. Ensure the load is higher than 10% of the range for the meter installed.

F. Prepare a test and inspection reports, including all tests and readings obtained during the field quality control tests.
   1. Include all readings
   2. Include expected results and actual results
   3. Identify meters not meeting testing criteria

G. Replace meters not meeting testing criteria unless the issue can be corrected

3.5 COMMISSIONING

A. See section 25 55 00 for additional information

END OF SECTION