5.24 Metering Systems for Campus Infrastructure

Every energy and water stream to buildings shall be metered and integrate fully with University owned monitoring platforms. Prime consultants are responsible for ensuring that all proposed metering equipment and system configurations meet current operational, maintenance, and data reporting requirements. Any variance to this section must be approved by the Energy Management Group.

5.24.1 General

1. All buildings and structures on campus shall be metered.
2. The metering system will be designed to meet the requirements of sections 6.3.3 Water Consumption Management and 7.3.3 Energy Consumption Management of the latest ASHRAE 189.1 Standard and meet the LEED requirements specific to the project.
3. Heating water, chilled water, steam, natural gas and water meters shall report to the BMS system and to the Data Analytics Software.
4. Electrical meters shall report to the Power Monitoring Enterprise software and to the Data Analytics Software.
5. The data analytics must report points at 15 minute intervals.
6. Buildings must have University owned meters, using utilities meters to report is not acceptable.
7. Out-leased spaces utilities shall be metered to accurately capture the space energy and water usage.
8. All meters shall be installed following manufacturer's recommendations.
9. Documentation submitted shall include as-builts showing the actual location of the meters and the calibration certificates associated with flow meters.

5.24.2 Devices Location

1. Primary meters are necessary to accurately represent the total building energy and water performance. Sub-meters are meters providing additional system information but are not essential to capture the total building performance.
2. The primary meter shall be a physical meter. It is not acceptable to use a virtual meter or calculated variable.
3. All meter heads, flow meters, BTU meters, and temperature sensors shall be installed indoors in a safely accessible location that meets manufacturer requirements.
4. Flow meters shall capture the flow returning to the tunnel DES distribution, meaning, if there is a by-pass, the flow meter shall not capture the re-circulating flow. The flow meter shall be located on the tunnel side of the bypass, not on the building side.

5. Meters shall include a local meter head displaying the current reading.
6. Meter heads and BTU meters shall be rigidly mounted approximately 1.5 m above finished floor level in locations protected from moisture, mechanical impact, and other potential damage.
7. Where feasible, a bypass line shall be installed to allow maintenance with minimal system interruption.
8. All hydronic and gas meter installations shall include isolation valves.

5.24.3 Hydronic Metering Requirements (heating and chilled water meters)

1. Heating and Chilled Water Meter types
    a. Primary heating water meter shall be inline Endress+Hauser Promag P-10 meter (24V) rated for at least 130 C with a BTU meter communicating using modbus TCP/IP.
    b. Primary chilled water meter shall be inline Endress+Hauser Promag P-10 meter (24V) with BTU meter using modbus TCP/IP.
    c. Sub-meters shall be the same Endress+Hauser Promag P-10 or a pipe surface ultrasonic clamp-on meter (Endress+Hauser or Badger).
    d. Using standalone meters for sub-metering is preferred over using energy valves.
    e. BTU meters shall be used to do energy calculations.
2. Installation
    a. Flow meters
        i. Flow meters shall be installed on the return line.
        ii. Flow meters grounding conductors shall be kept as short as practicable.
        iii. The contractor installing the meter is responsible for verifying and providing proof the flow accuracy is within 1% when compared to a portable flow meter.
    b. Temperature Sensors
        i. RTD sensor cable length to the BTU meter shall be kept as short as practicable while understanding the length cannot be modified during the installation without significantly impacting the accuracy.
        ii. For primary meters, thermowell temperature sensors shall be used, no strap-ons.
        iii. For sub-meters, thermowell is preferred but pipe surface RTDs can be used in retrofit applications.

c. Communication

i. BTU meters shall have BACnet over ethernet IP communication or modbus TCP/IP. Note the modbus TCP/IP feature requires an added module to the base Endress+Hauser BTU meter.

ii. In addition, BTU meters shall have the power point hardwired to the BMS panel.

iii. In some instances such as retrofits, such as for sub-meters, it may be acceptable to use flow and temperature signals to do energy calculations in the BMS, this method shall be approved by the Energy Management team.

3. Data and Reporting

a. The controls contractor shall perform verifications to ensure meter readings on the head of the meter and in the BMS are within 0.5% when totalizing energy over a day.

b. Temperature sensors and flow meters must be visible on the BMS graphic with a representation of their actual location in the hydronic system.

c. Controls contractor shall program and display on the BMS the following:

i. For Heating Water:
- Yesterday's energy daily total (GJ/day)
- Current flow (lps)
- Current demand (MW)
- Cumulative energy demand for the current day (GJ)

ii. For Chilled water:Yesterday's energy daily total (MMBtu/day)
- Current flow (lps)
- Current demand (MMBtu/h)
- Cumulative energy demand for the current day (MMBtu)

d. Yesterday’s energy daily total shall be trended on COV (10-5) in the BMS.

5.24.4 Water Meters (Other than thermal meters)

1. Meter Types

a. Potable domestic cold water including RO water: Use Compound Displacement Turbine (Neptune or Badger) with a pulse output to BMS.

b. Domestic water meters shall meet the AWWA C702 standards minimum requirements and comply with the lead-free provisions of the Safe Drinking Water Act.

c. River water, recycled rainwater, and other water that may have suspended matter: Use inline magnetic flow meter or ultrasonic clamp-on with hardwired pulse output to BMS.

2. Installation

    a. Flow Meter

        i. The total domestic water usage to a building shall be metered.

        ii. Domestic water used as a back-up method for cooling shall be metered and have a flow switch signal to the BMS indicating when it is enabled.

        iii. A valved by-pass shall be installed to allow maintenance of the meter.

        iv. The contractor installing the meter shall provide a proof of verification showing the meter accuracy is within 2%.

        v. Meters shall have a local display showing the usage to date.

    b. Communication

        i. Communication back to the BMS shall be a pulse output.

3. Data and Reporting

    a. The controls contractor shall perform verifications to ensure meter readings on the head of the meter and in the BMS are within 0.5% when totalizing water over a day.

    b. Controls contractor shall program and display on the BMS the following:

        i. Yesterday's total water usage (m3/day)

        ii. Current volume (m3)

        iii. Cumulative water demand for the current day (m3)

    c. Yesterday's water daily total shall be trended on COV (10-5) in the BMS.

5.24.5 Steam Meters

Where system configuration allows, condensate return metering shall be the first option for energy measurement. Where condensate metering is not feasible, steam meters shall be installed on the steam supply line. For systems with highly variable flow or short-cycling loads, alternative steam meter technologies may be evaluated, subject to Energy Management approval.

1. Meter Type

    a. Condensate method: Insertion turbine meter or magnetic flow meter to capture the flow most accurately where pipe diameter is small and flow varies significantly.

    b. Direct method: Vortex meter with BTU meter.

2. Installation

a. Condensate method

i. Where there is a steam generator, the meter shall be installed to capture feed water to the steam generator, either from the condensate tank discharge line, or from the make-up water line if there is no condensate return.

ii. Temperature sensor shall be installed to measure water temperature into the steam generator.

iii. The total water flow into the steam generator and its temperature shall be used to do an enthalpy calculation in the BMS.

b. Direct method

i. Install on the steam supply line to capture total mass flow and as per manufacturer recommendations.

c. Communication

i. Hard wire mass flow, flow, temperature, pressure to the BMS using 4-20 mA or BACnet/IP or modbus TCP/IP depending on the type of meter used.

3. Data and Reporting

a. The controls contractor shall perform verifications to ensure BTU meter readings and the BMS are within 1% when totalizing energy over a day.

b. Flow meter, temperature sensors and pressure sensors must be visible on the BMS graphic with a representation of their actual location in the hydronic system.

c. Controls contractor shall program and display on the BMS the following:

i. Yesterday's energy daily total (GJ/day)

ii. Current mass flow (steam) (GJ/h) or flow (water) (lps)

iii. Cumulative energy demand for the current day (GJ)

iv. Steam Pressure (psi)

v. Water Temperature (C)

d. Yesterday’s water daily total shall be trended on COV (10-5) in the BMS.

5.24.6 Natural Gas Meters

1. Meter Type

a. Inline thermal mass flow meter Onicon or Sage gas meter.

2. Installation

a. Flow Meter

i. Natural gas meter shall be installed to capture the building total Natural gas usage.

ii. The meter shall have a valved by-pass for maintenance.

b. Communication

i. Communication back to the BMS shall be hard wired 4-20 mA. BACnet/IP can be used if available.

3. Data and Reporting

a. The controls contractor shall perform verifications to ensure meter readings on the head of the meter and in the BMS are within 1% when totalizing energy over a day.

b. Controls contractor shall program and display on the BMS the following:

i. Yesterday's energy daily total (GJ/day)

ii. Current flow rate (m3)

iii. Current energy demand (GJ/h)

iv. Cumulative energy demand for the current day (GJ)

c. Yesterday’s water daily total shall be trended on COV (10-5) in the BMS.

5.24.7 Electrical Meters

This section describes the electrical power monitoring system at the University of Calgary, the components, and the requirements for installation. The new installation shall be performed to provide a complete electrical power monitoring system utilizing existing hardware and software infrastructure and additional infrastructure and/or devices for new equipment.

This section is in addition to section 5.24. Any variance from this section shall be approved by the Electrical Utilities department.

1. General

a. Reference Standards and Certifications. The electrical power monitoring system shall have the following minimum listings and/or certifications according to the most recent editions of the following:

i. Safety: ANSI/UL 61010-1 – Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

ii. Accuracy: ANSI C12.20 Electricity Meters – 0.1, 0.2, and 0.5 Accuracy Classes
- Class 0.2

iii. Electromagnetic Compatibility (EMC): FCC Title 47, Part 15

- Subpart B, Class A

b. Labeling shall be coordinated with the EUD at the design stage

c. University owned electrical meters shall capture the total building energy usage as well as any renewable electrical energy production according to section 5.24 general notes.

d. Submittals

i. Provide an electrical single line diagram complete with all metering locations and network connections.

ii. Provide metering test report.

2. Meter Type

a. Acceptable Manufacturers

i. Schneider Electric

ii. The listing of specific manufacturers does not imply acceptance of their products; not all manufacturer products meet these specifications.

iii. Use of acceptable manufacturers in no way relieves manufacturers of complying will all aspects of these specifications including ratings, features, and functions.

iv. Products in compliance with these specifications and manufactured by others not named will be considered only if pre-approved by the Engineer and the University of Calgary prior to submission of bid. Alternate products must be capable of providing all required functionality as a complete system using existing University infrastructure. Alternate products must be submitted according to the requirements of Division 01.

b. Acceptable Devices

i. All metering devices shall be microprocessor based by a single manufacturer.

ii. Main Incoming Service Feeders – Located at every 600V main service location. A main service location is defined as a main breaker on the secondary of a 13.2kV-600V transformer or the main breaker for a building distribution. Main-Tie-Main locations must have separate meters on both main breakers.

iii. Metering devices shall have enough inputs to measure all indicated parameters.

iv. Main Feeder Meters: Schneider Electric PowerLogic ION9000 Series or latest meter that is comparable.

v. Branch and Sub-Meters: Schneider Electric PowerLogic PM5000 Series

or latest comparable meter

vi. Photo-Voltaic Meters: Schneider Electric PowerLogic PM8244 or latest comparable bidirectional meter.

vii. Ethernet Gateways: Schneider Electric Link 150 EGX150 or PAS600L Gateways are only to be used in conjunction with sub-meters without direct ethernet connections. Gateway is to be Power over Ethernet (PoE) where building infrastructure supports or provided with external power supply.

3. Features and functions of Main Feeder meters shall include:

   a. Device shall be capable of recording events, including waveforms, based on user-definable triggers and alarms.

   b. Events are to be kept in memory indefinitely until space is required, at which time oldest events are to be over- written first.

   c. All events shall be viewable along with captured parameters and waveforms from remote display.

   d. Device shall be capable of monitoring and recording all electrical parameters once per cycle with a sampling rate of 4096 samples per cycle.

   e. Device shall be able to evaluate the supply power quality based on the EN 50160 standard.

   f. Device shall be capable of forming energy trends and forecasting energy consumption based on present and historical energy usage.

   g. Device shall have default alarms (ex. loss of voltage) as well be capable of custom alarms that can be set based on any of the measured parameters.

   h. Device shall visually indicate breaker status and provide alarm to PME interface.

4. Measured parameters of Main Feeder meters shall include:

   a. Current – A, RMS (A,B,C phases, three-phase average, neutral, and ground)

   b. Voltage – V, RMS (A-B, B-C, C-A, phase average, A-N, B-N, C-N, phase to neutral average, N-G)

   c. Real Power – W, (A,B,C, Three-Phase)

   d. Apparent Power – VA, (A,B,C, Three-Phase)

   e. Reactive Power – VAR, (A,B,C, Three-Phase)

   f. Energy – VARh, VAh, Wh (accumulated, incremental, and conditional. A,B,C, Three-Phase)

   g. Demand – A, VAR, VA, W (present, running average, last interval, peak. Three-

Phase)

h. Power Factor

i. Frequency - Hz

j. Power Quality – including:

i. Harmonics (up to 63rd order)

ii. Unbalance

iii. Harmonic Distortion – ITHD (A,B,C, and N)

iv. Harmonic Distortion – VTHD (A-B,B-C,C-A, A-N, B-N,C-N)

v. Voltage Sags/Swells

vi. Voltage Transients (0.2µs)

vii. Flicker (Pst and Plt)

5. Features and functions of Branch and Sub-Metering shall include:

a. Device shall be capable of monitoring and recording all electrical parameters once per cycle.

b. Device shall have default alarms (ex. loss of voltage) as well be capable of custom alarms that can be set based on any of the measured parameters.

6. Measured parameters of Branch and Sub-Meters shall include:

a. Current – A, RMS (A,B,C phases, three-phase average, neutral, and ground)

b. Voltage – V, RMS (A-B, B-C, C-A, phase average, A-N, B-N, C-N, phase to neutral average, N-G)

c. Real Power – W, (A,B,C, Three-Phase)

d. Apparent Power – VA, (A,B,C, Three-Phase)

e. Reactive Power – VAR, (A,B,C, Three-Phase)

f. Energy – VARh, VAh, Wh (accumulated, incremental, and conditional. A,B,C, Three-Phase)

g. Demand – A, VAR, VA, W (present, running average, last interval, peak. Three-Phase)

h. Power Factor

7. Features and functions of Photo-Voltaic Meters shall include:

a. Device shall be capable of measuring bi-directional energy flow.

b. Features, functions, and measurement parameters listed for sub-metering also

apply to photo-voltaic metering.

8. Installation

   a. Meter and Remote Display

      i. Remote display to be located as close to source equipment as possible.

      ii. All metering devices shall come complete with remote display capable of being mounted up to 30 feet away. Remote displays for branch panels shall not me mounted less than 1400mm from the floor.

      iii. Metering devices shall have voltage inputs capable of receiving direct line voltage inputs, or shall be provided with the suitable accessories to change from line voltages to input voltage levels required by device.

      iv. Meters devices shall not be incorporated into branch panels. Installation shall be in separate Meter cabinet with appropriate lamacoid required.

      v. Meter shall be installed with the latest firmware available.

      vi. Photo-voltaic systems shall have a dedicated University owned meter in addition to the inverters.

      vii. Sites with a utility provider meter still require a dedicated University owned meter.

      viii. The installation of current and potential transformers shall be coordinated with the installation of protective relaying and other equipment.

      ix. The location of meter device remote displays with University of Calgary shall be approved by EUD and follow equipment manufacturer recommendations.

      x. Where required for a complete metering system, supply all required instrument transformers. Instrument transformers shall not limit the meter accuracy class.

   b. Communication

      i. Devices shall be compatible with the existing Schneider PME system available on campus.

      ii. Provide all required hardware, software, and programming required to integrate new devices into the existing PME.

      iii. Devices shall come complete with RJ-45 ethernet network port for TCP/IP communication back to the University network.

      iv. All cabling shall be CMP rated CAT 6 cabling.

      v. Meter ethernet cabling external to equipment enclosures shall be run in 21mm EMT conduit.

vi. Meters within close proximity shall be daisy chained.

vii. The contractor shall coordinate with University of Calgary EUD for meter labeling prior to field programming.

viii. The contractor shall coordinate with the Project Manager and UCIT the connection point and IP addresses for all new devices including:

ix. Identify with University of Calgary IT department (UCIT) the room/switch location for cable termination.

x. Request a new static IP address for each installed device.

xi. Label all cables as per by UCIT requirements.

xii. Testing of the port to ensure it is activated.

xiii. The manufacturer field service technician shall perform field programming including alarm set points, parameter interval definition, trends, communication, and accuracy verification.

xiv. Test reports and connection to PME interface to be reviewed and confirmed by University of Calgary EUD representative.

xv. Manufacturer Technician shall perform the interface programming on the PME server so the meter interface is accessible via the existing Vista campus map.

9. Data Monitoring and Reporting

   a. Trends shall be setup at the meter to capture the following measurements every 15 minutes:

      i. Real Power

      ii. Apparent Power

      iii. Reactive Power

      iv. Energy

Revision History

Revision Date	Version	Description
March 27, 2026	1.0	New standard published