SECTION 230510 – BUILDING SERVICE ENERGY METERS – CHILLED WATER & STEAM

1.0 ASHRAE 90.1 Compliance: University of Pennsylvania buildings shall comply with the Commercial Energy Efficiency Requirements of ASHRAE Standard 90.1-2016. The ASHRAE 90.1-2016 compliance paths shall be followed instead of the International Energy Conservation Code (IECC) requirements as permitted by 2018 IECC Section 401.2 Application.

2.0 All buildings on the University campus shall have chilled water and/or steam meters installed on the incoming building service if they are served by the campus chilled water system and/or the local steam utility.

3.0 Chilled Water:

A. Chilled water plant monitoring shall be provided in accordance with the requirements of Section 6.4.3.11 of ASHRAE 90.1-2016.

B. Chilled water energy meters shall be installed on the primary chilled water supply or return piping after the isolation valves from the primary chilled water system. Each flow meter shall be accompanied by a temperature transmitter in both the primary chilled water supply and return piping.

C. Flow Meter: Yokogawa Model AXF with Remote Flowtube and Converter. Converter shall have operating panel and display. Converter shall use the Brain Protocol. Additionally, the factory terminated leads from the meter to the converter shall not be cut, spliced or otherwise modified in the field.

D. Alternate (only with approval of University Engineering Department): Veris Accelabar/ Armstrong, with Emerson or Foxboro DP transmitter, with Anderson Greenwood manifold isolation and RTD below.

E. Temperature Transmitter: PR Electronics 4114 2-3-4 wire Universal DIN-rail mounted temperature transmitter to be mounted in the flow computer enclosure. The PR 4114 transmitter shall be equipped with the PR 4511 Modbus RTU over RS-485 communications enabler.

1. Element – Tip Sensitive 100 ohm RTD TCR 0.00385.
2. Enclosure shall be Reotemp “V” Ball-dome Aluminum flip-top (NEMA 4). No conduit bodies are to be used to house connections to the RTD.
3. Provide Spring loaded Holder.
4. Thermowell; ¾ or ½ inch, 316 SS Model TW 222 or 1218 U (sized to enter ⅓ the installed pipe diameter; add extension nipples to extend beyond insulation.) Thermowell shall be filled at least 1/3 full with heat conducting grease as manufactured by Dow Chemical. Grease shall be injected into well using a syringe or similar tool to ensure grease is filled without voids, allowing for a reliable thermal connection between the RTD and thermowell.

F. Alternate (only with approval of University Engineering Department): Temperature Transmitter: PR Electronics 7501 Field Mounted Temperature Transmitter

5. Element – Tip Sensitive 100 ohm RTD TCR 0.00385.
6. Enclosure shall be Reotemp “V” Ball-dome Aluminum flip-top (NEMA 4). No conduit bodies are to be used to house connections to the RTD.
7. Provide Spring loaded Holder.

8. Thermowell; ¾ or ½ inch, 316 SS Model TW 222 or 1218 U (sized to enter ½ the installed pipe diameter; add extension nipples to extend beyond insulation.) Thermowell shall be filled at least 1/3 full with heat conducting grease as manufactured by Dow Chemical. Grease shall be injected into well using a syringe or similar tool to ensure grease is filled without voids, allowing for a reliable thermal connection between the RTD and thermowell.

4.0 Steam:

A. Steam energy meters shall be installed on the primary high pressure side of the incoming service, prior to the PRV station. Steam is considered to be slightly superheated, so energy metering must compensate for temperature and pressure. Steam meters shall have a flanged connection at both the meter and outside the reducers before transitioning to meter line size. Each flow meter shall be accompanied by a temperature transmitter and pressure transmitter installed downstream. Pressure transmitter shall be mounted vertically above the pipe penetration and have an isolation valve followed by a pigtail, a second isolation valve, and a port for calibration.

B. Flow Meter: Yokogawa Model DY, flanged, with Remote Flowtube and Converter. Converter shall have operating panel and display. Brain Protocol capable.

C. Alternate (only with approval of University Engineering Department): Veris Accelabar, with Emerson or Foxboro DP transmitter, with external pressure transmitter and RTD below.

1. Temperature Transmitter: PR Electronics 4114 2-3-4 wire Universal DIN-rail mounted temperature transmitter to be mounted in the flow computer enclosure. The PR 4114 transmitter shall be equipped with the PR 4511 Modbus RTU over RS-485 communications enabler.Element – Tip Sensitive 100 ohm RTD TCR 0.00385.
2. Enclosures shall be Reotemp “V” Ball-dome Aluminum flip-top (NEMA 4). No conduit bodies are to be used to house connections to the RTD.
3. Provide Spring loaded Holder
4. Thermowell; ¾ or ½ inch tapered, 316 SS Model TW 1218 or 1218 U (sized to enter ½ the installed pipe diameter; add extension nipples to extend be yond insulation.) Thermowell shall be filled at least 1/3 full with heat conducting grease as manufactured by Dow Chemical. Grease shall be injected into well using a syringe or similar tool to ensure grease is filled without voids, allowing for a reliable thermal connection between the RTD and thermowell.
5. Pressure Transmitter – Yokogawa EJA530 with Hart Protocol

5.0 General Notes for All Meters:

A. Provide a full size isolation and bypass around each meter.

B. No conduit bodies are to be used to house connections to the RTD.

C. All flow converters shall be powered from the KEP enclosure. The switch specified in D below shall also de-energize the flow converters.

D. The flow meter, temperature transmitters, (and pressure transmitters for steam meters) shall be connected to a Kessler Ellis Products (KEP) Flow Computer. The KEP shall be located within 20’ 0” of the meter and installed at 5’ 6” above the floor on a column, wall, or constructed support stand only. Additionally, each KEP shall be installed in its own cabinet. Multiple KEP’s shall not be installed in a single cabinet. A double gang box with ¾” conduit to an accessible ceiling will be required within 4’ 0” of each meter for Penn Net

to provide an Ethernet connection. The KEP shall be connected to the PennNet Ethernet connection via CAT-6 Ethernet cable. Additionally, a single duplex 110V power and switch outlet and shall be provided either within each cabinet housing the KEP, or externally to provide power for systems technicians for future service work. The switch shall disconnect power to the devices in the KEP cabinet.

E. Flow Computer: KEP ES 749. Provide for each meter.

1. MOXA MGATE MB3170 1 Port RD-232/422/485 advanced Modbus TCP to Serial communications gateway.
2. SUPERtrol II RS 485 option with Modbus protocol.
3. 24V DC Power Supply Pulse 30 watt, model ML30.100 din rail mount, or equal with 110V input.
4. KEP Model MS799 NEMA 4X enclosure
5. Externally mounted duplex electrical outlets shall be mounted flush to edge of enclosure.

F. Meters shall be designed based on the annual range of flows to be experienced. If necessary, multiple meters shall be installed to measure flow during low load/flow conditions that are outside the turndown of the meter needed for full flow.

G. The location of the meters shall be in accordance with the manufacturer's requirements for upstream and downstream straight lengths of piping.

H. Install meters (including flow, temperature and pressure measuring devices) in accessible locations for servicing and replacement. Use flanges, valves, and piping bypasses and spool pieces to permit removal of the meters without interrupting service.

I. Provide calibration proof and forms to NIST standards as part of submittal process.

J. Insulate in line meters with removable covers.

K. Provide dedicated 120V power circuit to supply power to the metering from a local source and 24V DC power supplies as needed to support the meters. The circuit panel and circuit breaker shall be permanently identified inside the KEP cabinet in a clearly visible location.

L. Engage University approved Integrator to provide graphics and communications to the University's OCC SCADA system and Energy Management System. At a minimum the following information will have the capability to be logged and trended in 15 minute increments through the SCADA system:

1. Chilled Water:

a Instantaneous Flow (GPM)
b Cumulative Chilled Water Use (Gallons)
c Instantaneous Energy Flow (kBTU/hr, Ton hrs)
d Cumulative Energy Use (mmBTU's, Ton days)
e Supply Water Temperature
f Return Water Temperature
g Differential Temperature

2. Steam:

a Steam Supply Pressure (lbs)

b Steam Supply Temperature (Deg. F)
c Instantaneous Mass Flow Rate (lbs/hr)
d Totalized Mass Consumption (mlbs)
e Steam pressure and temperature compensation (Super Heat)
f Instantaneous Energy Flow (kBTU/hr)
g Cumulative Energy Use (mmBTU)