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BuildingName
The Description of the Project
P00000000 0000

SPECIFICATION DIVISION 33

NUMBER SECTION DESCRIPTION

DIVISION 33 UTILITIES
SECTION 336333 - THERMAL ENERGY UTILITY METERING

END OF CONTENTS TABLE

DIVISION 33 UTILITIES
SECTION 336333 - UTILITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 01 Specification Sections, and other applicable Specification Sections, in particular the Related Sections listed below, apply to this Section.

B. Related Sections:

1. Section 017823 - Operation and Maintenance Manuals
2. Section 09110 – Tunnels - Quality Assurance & Quality Control
3. Section 336100 – Hydronic Utilities
4. Section 336330 – Utility Tunnels – Steam & Condensate Distribution Systems

1.2 SUMMARY

A. This Section includes:

1. 2.1 Steam Flowmeters (Utility Owned)
2. 2.2 Condensate Flowmeters (Utility Owned)
3. 2.3 Condensate Return Units (Utility Owned)
4. 2.4 Hydronic Flow Meters (Utility Owned)

1.3 SUBMITTALS

A. Shop Drawings Submit the following project specific items for approval in compliance with Division 1:

1. Product Data: Include manufacturer, catalog illustrations, model, rated capacities, performance, dimensions, component sizes, rough in requirements, materials of construction, and operating and maintenance clearance requirements.
2. Shop drawings for flowmeters are to include meter size, upstream and downstream straight lengths, multivariable options and sensors, and electronics enclosure requirements.
3. Provide data sheets for all products listed in this section.
4. Submit all submittals for a given system or component at the same time.

B. Test Reports

C. Warranty Documentation

D. Installation, Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials and equipment raised off the floor on pallets and protected with coverings to prevent damage due to weather and construction activities. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Arrange coverings to provide air circulation to avoid damage from condensation or chemical build-up. Protect from damage, dirt and debris at all times.

1.6 WARRANTY

A. Provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STEAM FLOWMETERS (UTILITY OWNED):

1. This meter application is for buildings utilizing steam meters for steam recharge billing. Inline vortex type meters are to be used for services with a < 4" pipe size. Insertion vortex shedding type meters are to be used for services with a ≥ 4" pipe size.
2. Flow measuring devices are to be selected based on minimum flow rates. Refer to table below for selection criteria.
    a. When it is anticipated that the building will have little to no steam load the minimum flow rate shall be 10% of the maximum load.
3. The meter system shall consist of a primary flow sensor and transmitter. The flowmeter and transmitter as a unit shall have the following minimum characteristics:
    a. Accuracy:
        1) Inline vortex type meter (Flange style)(< 4" pipe size)
            a) Volumetric Flow: +/-1.0% of rate (steam)
            b) Mass Flow: +/-1.5% of rate (steam)
            c) Temperature: +/-2.0 deg F
            d) Pressure: +/- 0.3% of full scale
        2) Insertion vortex shedding type meter (Inserted through side of pipe)(4" pipe size)
            a) Volumetric Flow: +/-1.5% of rate (steam)
            b) Mass Flow: +/-2.0% of rate (steam)
            c) Temperature: +/-2.0 deg F
            d) Pressure: +/- 0.3% of full scale
    b. Repeatability shall be 0.2% of mass flow rate.
    c. Each meter shall be factory calibrated for the specified flow range prior to shipment and specific performance test data shall be furnished with the meter.
    d. Meter range shall accommodate the minimum and maximum expected flow of steam at the installed location.
    e. Meter shall be equipped with a temperature and pressure compensation feature.
    f. Flow sensor body material and wetted parts shall be 316L stainless steel.

g. Multivariable options shall include velocity, temperature and pressure sensors.
h. Meter electronics enclosure shall be NEMA 4x with integral LCD display and programming buttons. Meter electronics are to be installed no more than 5’ above finished floor, provide remote mounting brackets and cable where required. Remote mounted enclosure is to be mounted on wall or fabricated stand. Provide with standard 50’ of cable when remote mounting of the electronic head is required, request extended cable lengths from manufacturer as required up to 100’.
i. Meter shall be powered over ethernet.
j. Meter shall have one analog output (4-20 mA), one alarm, one pulse, and MODBUS TCP/IP communication protocol.
k. The flowmeter shall have a process temperature rating of 500F (260C).
l. Meters in the low pressure steam system (9 – 12 psig)shall have a pressure sensor rated for 30 psia. Meters in the high pressure steam system (60 psig) shall have a pressure sensor rated for 100 psia.
m. Meter shall have an ambient operating temperature range of -40 degree F to 140 degree F.
n. Applicable only for inline vortex type meters (Flange style)(< 4” pipe size)
    1) The flow sensor shall be equipped with 150-lb. flanges.
o. Applicable only for insertion vortex shedding type meters (Inserted through side of pipe)(≥ 4” pipe size)
    1) Meter shall have a standard probe length.
    2) Meter shall have a packing gland connection, 2 inch 150# flange, and permanent retractor.
    3) Provide with class 150, carbon steel, 2 inch flange adaptor.
    4) Provide with class 150, carbon steel, full port, 2 inch flanged gate valve.

4. The meter shall transmit the following points: Totalizer (gal), Temperature (deg F), Pressure (psig), Flow (PPH)
5. The flow meter shall be manufactured by an ISO9001 certified company.
6. The flowmeter shall have no moving parts and must be a vortex shedding type utilizing the Von Karman effect to measure volumetric flow.
7. The transmitter shall be capable of being field calibrated and reprogrammed from the outside housing via magnetic probe or security protected integral keypad menu switching and Hart capable.
8. Unit electronics shall have noise immunity.
9. Unit shall have the capability to maintain flow total in non-volatile memory.
10. The flowmeter shall be provided with a 1-year warranty and application non-degradation performance guarantee.
11. Applicable only for inline vortex type meters (flange style) (< 4” pipe size)
    a. The flowmeter design must be a cantilevered beam dual piezoelectric crystal configuration that is non-wetted all welded and fully isolated and provide immunity to common mode noise and pipe vibration.

b. The flowmeter shall have no internal cavities that can clog causing the meter to lose functionality.
c. The flow sensor shall be hydrotested at 1.5 times the cold work pressure for 10 minutes.
d. The flow sensor shall have options for fully integrated velocity, temperature, and pressure sensors for calculating volumetric flow, density, energy, and mass flow readings from a single point of installation in the pipe.
e. The optional multivariable sensors shall be embedded near the velocity measurement point and shall be fully enclosed within the flow meter.

12. Approved Manufacturers:
    a. Vortek
    b. Spirax Sarco

B. Inline vortex type meter (Flange style)(< 4” pipe size)

Building Steam Load(lbs/hr)	Pipe Size (in)	Steam Meter (9 psig – 12 psig steam pressure)	Steam Meter (60 psig steam pressure)
Min - 13 Max* - 110	3/4"	VORTEK: M24-VTP-06S150-R(50)-DD-DCHPOE-1AMIP-ST-P1-S3019 SPIRAX SARCO: VLM20-VTP-06S-150R50D-DHPOE1MS-P1-P-1	N/A
Min - 21 Max* - 262	1"	VORTEK: M24-VTP-08S150-R(50)-DD-DCHPOE-1AMIP-ST-P1-S3019 SPIRAX SARCO: VLM20-VTP-08S-150R50D-DHPOE1MS-P1-P-1	
Min - 53 Max* - 773	1-1/2"	VORTEK: M24-VTP-12S150-R(50)-DD-DCHPOE-1AMIP-ST-P1-S3019 SPIRAX SARCO: VLM20-VTP-12S-150R50D-DHPOE1MS-P1-P-1	
Min – 89 Max* - 1,292	2"	VORTEK: M24-VTP-16S150-R(50)-DD-DCHPOE-1AMIP-ST-P1-S3019 SPIRAX SARCO: VLM20-VTP-16S-150R50D-DHPOE1MS-P1-P-1	
Min – 199 Max* - 2,890	3”	VORTEK: M24-VTP-24S150-R(50)-DD-DCHPOE-1AMIP-ST-P1-S3019 SPIRAX SARCO: VLM20-VTP-24S-150R50D-DHPOE1MS-P1-P-1	
Min - 22 Max* - 324	3/4"	N/A	VORTEK: M24-VTP-06S150-R(50)-DD-DCHPOE-1AMIP-ST-P2-S3019 SPIRAX SARCO: VLM20-VTP-06S-150R50D-DHPOE1MS-P2-P-1
Min – 37 Max* - 770	1"		VORTEK: M24-VTP-08S150-R(50)-DD-DCHPOE-1AMIP-ST-P2-S3019 SPIRAX SARCO: VLM20-VTP-08S-150R50D-DHPOE1MS-P2-P-1
Min – 91 Max* - 2,270	1-1/2"		VORTEK: M24-VTP-12S150-R(50)-DD-DCHPOE-1AMIP-ST-P2-S3019 SPIRAX SARCO: VLM20-VTP-12S-150R50D-DHPOE1MS-P2-P-1
Min – 152 Max* - 3,793	2"		VORTEK: M24-VTP-16S150-R(50)-DD-DCHPOE-1AMIP-ST-P2-S3019 SPIRAX SARCO: VLM20-VTP-16S-150R50D-DHPOE1MS-P2-P-1
Min – 341 Max* - 8,485	3”		VORTEK: M24-VTP-24S150-R(50)-DD-DCHPOE-1AMIP-ST-P2-S3019 SPIRAX SARCO: VLM20-VTP-24S-150R50D-DHPOE1MS-P2-P-1

*Note 1: Maximum building steam load is based on peak diversified steam load.
Note 2: Minimum and maximum meter flow rates based on manufacturer minimum and maximum flow rates.
Note 3: Turndown is application dependent and can exceed 100:1. Consult minimum flow rate with manufacturer.

C. Insertion vortex shedding type meter (Inserted through side of pipe)(≥ 4" pipe size)

Building Steam Load(lbs/hr)	Pipe Size (in)	Steam Meter (9 psig – 12 psig steam pressure)	Steam Meter (60 psig steam pressure)
Min - 347 Max* - 5,030	4"	VORTEK: M23-VTP-SL-R(50)-DD-DCHPOE-1AMIP-ST-P1-P150R-S2382 SPIRAX SARCO: VIM20-VTP-S-R50-D-DHPOE-1MIP-S-P1-P150R	N/A
Min - 787 Max* - 11,405	6"		
Min - 1,378 Max* - 19,979	8"		
Min - 2,254 Max* - 32,668	10"		
Min - 594 Max* - 14,770	4"	N/A	VORTEK: M23-VTP-SL-R(50)-DD-DCHPOE-1AMIP-ST-P2-P150R-S2382 SPIRAX SARCO: VIM20-VTP-S-R50-D-DHPOE-1MIP-S-P2-P150R
Min - 1,348 Max* - 33,488	6"		
Min - 2,362 Max* - 58,664	8"		
Min – 3,862 Max* - 95,919	10"		
*Note 1: Maximum building steam load is based on peak diversified steam load. Note 2: Minimum and maximum meter flow rates based on manufacturer minimum and maximum flow rates.			

2.2 CONDENSATE FLOW METER (IN-LINE VORTEX TYPE) (UTILITY OWNED):

1. This meter application is for buildings utilizing condensate meters for steam recharge billing.
2. The meter shall be sized appropriately for the range of flow for the system.
3. The meter system shall consist of a primary flow sensor and transmitter. The flowmeter and transmitter as a unit shall have the following minimum characteristics:
   a. Accuracy:
      1) Volumetric Flow: +/-0.7% of rate (liquids)
      2) Mass Flow: +/-1.0% of rate (liquids)
      3) Temperature: +/-2.0 deg F
   b. Repeatability shall be 0.2% of mass flow rate.
   c. Each meter shall be factory calibrated for the specified flow range prior to shipment and specific performance test data shall be furnished with the meter.
   d. Meter range shall accommodate the minimum and maximum expected flow of condensate at the installed location.
   e. Flow sensor body material and wetted parts shall be 316L stainless steel.
   f. Multivariable options shall include velocity (ft/s) and temperature sensors.
   g. The flow sensor shall be equipped with 150-lb. flanges.

h. Meter electronics enclosure shall be NEMA 4x with integral LCD display and programming buttons. Meter electronics are to be installed no more than 5’ above finished floor, provide remote mounting brackets and cable where required. Enclosure is to be mounted on wall or fabricated stand. Provide with standard 50’ of cable when remote mounting of the electronic head is required, request extended cable lengths from manufacturer as required.
i. Meter shall be powered over ethernet.
j. Meter shall have one analog output (4-20 mA), one alarm, one pulse, and MODBUS TCP/IP communication protocol.
k. The flowmeter shall have a process temperature rating of 500F (260C).
l. Meter shall have an ambient operating temperature range of -40 degree F to 140 degree F.

4. The meter shall transmit the following points: Totalizer (gal), Temperature (deg F)
5. The flow meter shall be manufactured by an ISO9001 certified company.
6. The flowmeter shall have no moving parts and must be a vortex shedding type utilizing the Von Karman effect to measure volumetric flow.
7. The flowmeter design must be a cantilevered beam dual piezoelectric crystal configuration that is non-wetted all welded and fully isolated and provide immunity to common mode noise and pipe vibration.
8. The flowmeter shall have no internal cavities that can clog causing the meter to lose functionality.
9. The flow sensor shall be hydrotested at 1.5 times the cold work pressure for 10 minutes.
10. The optional multivariable sensors shall be embedded near the velocity measurement point and shall be fully enclosed within the flow meter.
11. The transmitter shall be capable of being field calibrated and reprogrammed from the outside housing via magnetic probe or security protected integral keypad menu switching and Hart capable.
12. Unit electronics shall have noise immunity.
13. Unit shall have the capability to maintain flow total in non-volatile memory.
14. Approved Manufacturers:
    a. Vortek
    b. Spirax Sarco

Building Steam Load (lbs/hr)	Pipe Size (in)	Condensate Pump Flow	Condensate Meter
Max – 7,506	3/4"	Meter Size: 3/4" Pre-set Flow Rate: 15 gpm/each pump @ 40 psig head	VORTEK: M24-VT-06S-150-R(50)-DD-DCHPOE-1AMIP-ST-P0-S2383 SPIRAX SARCO: VLM20-VT-06S-150-R50-D-DHPOE-1MIP-S-P0
Max – 25,020	1"	Meter Size: 1" Pre-set Flow Rate: 30 gpm/each pump @ 40 psig head	VORTEK: M24-VT-08S-150-R(50)-DD-DCHPOE-1AMIP-ST-P0-S2384 SPIRAX SARCO: VLM20-VT-08S-150-R50-D-DHPOE-1MIP-S-P0
Max – 55,044	1-1/2"	Meter Size:1-1/2" Pre-set Flow Rate: 60 gpm/each pump @ 40 psig head	VORTEK: M24-VT-12S-150-R(50)-DD-DCHPOE-1AMIP-ST-P0-S2385 SPIRAX SARCO: VLM20-VT-12S-150-R50-D-DHPOE-1MIP-S-P0

2.3 CONDENSATE RETURN UNITS: ELECTRIC - SINGLE-STAGE, CENTRIFUGAL PUMPS WITH RECEIVER (UTILITY OWNED)

A. General

1. Provide packaged condensate return unit of size and capacity indicated.
2. Factory-fabricate packaged shall include electric-driven pumps, receiver, controls, and accessories suitable for operation with steam condensate.
3. Pump control electrical panel can be tank or remote mounted. If control panel is remote mounted manufacturer is to provide onsite startup.
4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
5. Incorporate automatic flow control valves and check valves per standard detail. Circuit setters are not an acceptable alternate for flow control valves.
6. Provide with integral thermometer.

B. Condensate Receiver Tank:

1. Cast iron or welded stainless-steel. Steel tanks are not acceptable.
2. Adjustable float with mechanical alternator.
3. Water-level gage and dial thermometer.
4. Pressure gage at pump discharge.
5. Pump suction isolation valves.
6. Lifting accommodations. (i.e., eyebolt taps or lifting lug points)
7. Inlet strainer with self-cleaning bronze or stainless-steel screen, dirt pocket, and cleanout plug on receiver inlet.

C. Condensate Pumps:

1. Centrifugal, close coupled.
2. Permanently aligned.
3. Stainless Steel or Bronze Impellers.
4. Stainless-steel shafts.

5. Mechanical seals rated at 250 deg F or greater.
6. Rated to operate with a minimum of 2 feet (6 kPa) of NPSH.
7. Pumps shall have a minimum 40 psig of head.

D. Pump Control Panel:

1. Factory wired between pumps and mechanical alternator contacts, for single external electrical connection.
2. Provide fused, control-power transformer.
3. NEMA 250, [Type 1] [Type 3R] [Type 12] enclosure with hinged door and grounding lug, mounted on pump or remote mount.
4. Motor controller for each pump.
5. Mechanical pump alternator to operate pumps in lead-lag sequence and allow both pumps to operate on receiver at high-level.
6. High-level alarm with local audible sound indicator and silencing switch. Provide optional alarm to BAS if desired.
7. Manual lead-lag control to override electrical pump alternator and manually select the lead pump.
8. Momentary contact "TEST" push button on cover for each pump.
9. Numbered terminal strip shall match corresponding electrical terminal numbering on schematics and indicate field wiring connection points.
10. Individual through cover pump power disconnects with locks.
11. Approved Manufactures: Spirax Sarco, Armstrong, Fabtek, Bell & Gossett, Vent Rite

E. Automatic Flow Control Valves for electric condensate return pumps:

1. The flow cartridge must be non-clogging single orifice design shall include no metal-to-metal contact, no segmented ports, no rolling diaphragm, and incorporate a tapered profile flow nozzle and metering disk controlled by a pressure compensating spring.
2. The flow cartridge shall be a single assembly, constructed with stainless steel moving parts and be accessible without removing the valve from the piping. Flow cartridges constructed with composite or rubber materials are not acceptable.
3. The flow cartridge shall be factory flow tested and calibrated to maintain accuracy of ±5%; the accuracy shall be maintained over standard operating range of 2 - 45 PSID. Cartridges that prevent flow above the maximum operating range are not acceptable.
4. The flow cartridge shall be clearly inscribed with the designed manufactured flow rate and must match pump design.
5. Approved Manufactures: Bell & Gossett, Nexus or approved equal

F. Check Valves for electric condensate return pumps:

1. Check valves shall be inline and spring type
2. Check valve shall have a 316 stainless steel body and disc.
3. Check valve spring shall be made from Inconel-X-750.
4. Check valve body to be seam welded together to eliminate need for O-ring or gasket.
5. Check valve shall incorporate a 5 psig cracking pressure
6. Approved Manufactures: Watson McDaniel, Durabula or approved equal

G. Vacuum Breakers:

1. Brass body, stainless steel retainer tube, ball and spring, rated for 365F, 300 psig.
2. Manufacturers: Hoffman, Spirax-Sarco, Bell & Gossett

2.4 HYDRONIC FLOWMETERS (UTILITY OWNED)

A. Liquid Electro-Magnetic Flowmeters:

1. The meter shall be sized appropriately for the range of flow for the system and shall be capable of bi-directional operation.
   a. Meters are to be sized for a minimum flow rate of 2.0 ft/sec. Piping immediately upstream and downstream of the meter are only to be decreased in size where required to ensure minimum flow rate is maintained. Piping is only to be reduced for the manufacturer recommended straight lengths of piping.
   b. When it is anticipated that the building will have little to no hydronic load the minimum flow rate shall be 10% of the maximum buildings load.
2. The meter system shall consist of a primary flow sensor and transmitter. The flowmeter and transmitter as a unit shall have the following minimum characteristics:
   a. Flowmeter Liner:
      1) Heating hot water and other water systems operating at or above 110°F: Teflon
      2) Chilled water and other water systems operating below 110°F: Polyurethane
   b. Flow sensor flange and body material shall be carbon steel.
   c. Accuracy:
      1) At 1 to 33 feet per second velocity: ±0.5% of rate.
      2) At 0.3 feet per second velocity: ±2% of rate.
   d. Repeatability shall be ±0.5% of mass flow rate.
   e. Each unit shall be wet-calibrated at the factory prior to shipment. Specific performance test data shall be furnished with the meter.
      1) Default calibration: Zero point, 2x25% and 2x90%
   f. The transmitter shall be capable of being field calibrated and reprogrammed from the outside housing via magnetic probe or security protected integral keypad menu switching.
   g. The flow sensor shall be equipped with 150-lb. flanges.
   h. Meter electronics enclosure shall be NEMA 4x with integral LCD display and programming buttons. Meter electronics are to be installed no more than 5’ above finished floor, provide remote mounting brackets and cable where required. Remoted mounted enclosure is to be mounted on wall or fabricated stand. Provide with standard 50’ of cable when remote mounting of the electronic head is required, request extended cable lengths from manufacturer as required.
   i. The electrodes shall be SS or Hasteloy.
   j. Unit electronics shall have noise immunity.

k. The meter system shall be installed with all necessary grounding components and gaskets per manufacturer's instructions.
l. Each meter shall provide a single 4-20 mA signal and a digital contact closure on reverse flow.
m. Meter shall have an ambient operating temperature range of -40 degree F to 140 degree F.

3. Approved Manufacturers (Water)
   a. ABB
   b. Siemens
   c. EMCO
   d. Vortek
   e. Rosemount
   f. Krohne
   g. Onicon

B. Resistance Thermometer Device Assembly

1. RTD Head Assembly: Cast aluminum, 1/2" NPT conduit connection, NEMA 4X protection rating, Ceramic Terminal Block
2. RTD Element: Length to be sufficient to extend into pipe 1/3 of pipe diameter, 1/4" element diameter, 316SS Sheath Material
3. Sensor Data: 3 wire, Type A accuracy, matched pair, 100ohm, standard range (-328F – 400F)
4. Well: 316 Stainless Steel, ¾" Pipe connection size, high thermal conduction gel
5. Wire: 24 gauge wire, wire lengths are not to exceed 150 feet.
6. Manufactures:
   a. Reotemp
   b. Rosemont
   c. Minco
   d. Intempco

C. BTU Computer

1. FloCalc
   a. Computer shall have three analog outputs capable of 4-20 mA (for DDC) used for transmitting flow and temperature.
      1) Meter shall be capable of measuring gas, steam, and liquid of varying specific gravities. The Btu computer shall be programmable to the fluid type.
   b. Capable of energy totalization in both directions.
   c. Capable of energy totalization in dual temperature systems.
   d. Modbus TCP/IP Communication protocol.
   e. Web browser user interface to all remote (not on site) programming and troubleshooting of the meter.
   f. Energy totalizing units: rTons (refrigerant tons), KrTons (1,000 rTons), BTU's, Mbtu's (1,000 Btu's), MMbtu's (1,000,000 Btu's)
   g. Computer shall calculate and display heat, mass or volume flow rate, resettable total, non-resettable total, temperature input 1, temperature input 2, delta temperature, density, pressure, peak demand, and time/date stamp.

h. Electronics enclosure shall be NEMA 4x with integral LCD display and programming buttons. Enclosure is to be installed no more than 5’ above finished floor, provide remote mounting brackets and cable where required. Enclosure is to be mounted on wall or fabricated stand. Provide with standard 50’ of cable when remote mounting of the electronic head is required, request extended cable lengths from manufacturer as required.
i. Capable of reading RTD resistance.
j. Computer shall transmit the following points as analog 4-20 mA signal: temperature 1, temperature 2, flow rate
k. Manufactures: Vortek Industries

PART 3 - EXECUTION

3.1 FLOW METERS

A. Installation

1. BTU metering components shall be installed per project drawings and University of Michigan standard details. Project specific drawings take precedence over University standard details.
2. BTU computer will be programed by University personal.
3. Ethernet cable shall be provided from IT switch, with power over ethernet port, for each BTU computer.
4. Temp 1, Temp 2 and flow outputs from BTU computer shall be a 4-20ma signal routed to DDC panel.
5. Wire termination lugs shall be used when terminating wires to components
6. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
7. Install flowmeter elements in accessible positions in concurrence with the University design standard details.
8. Install flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
9. In-line vortex and liquid electro-magnetic flowmeters are to be installed in a manor to ensure meter is always flooded.
10. Remote mount electronics enclosures on wall with a bracket or provide a stand off the floor.
11. Adjust faces of meters and gauges to proper angle for best visibility.
12. Clean meters and gauges. Replace cracked and broken windows.
13. Flowmeters are to be installed with the stem and electronics enclosure coming off the top half of the pipe between the 9 and 3 o’clock positions in horizontal piping.
14. Electro-magnetic electrode orientation shall be aligned horizontally in horizontal piping and aligned vertically in vertical piping.
15. Install flowmeters as shown on the project drawings and in accordance with the manufacturers recommendations.

a. Steam: Install meter as close to steam pipe entrance to building from utility tunnel as possible. Installation over 20 feet from the steam piping entrance into the building requires utilities approval. Meter is to be installed upstream of any branch takeoffs.
b. Condensate: Install meter downstream of common (utility specified) condensate return unit. Meter and CRU are to be located as close as possible to steam/condensate pipe entrance into building.
c. Hydronic Water: Flow meters are to be installed in supply piping.
    1) Install meter as close to hydronic pipe entrance to building from utility tunnel as possible. Installation over 20 feet from the hydronic piping entrance into the building requires utilities approval. Meter is to be installed upstream of any branch takeoffs.
    2) Plant installation (hydronic energy source) - Install meter as close to common header leaving energy plant as possible. Installation over 20 feet requires utilities approval. Meter is to be installed upstream of any branch takeoffs.

B. General Requirements - Controls Contractor:

1. Contractor to contact UM Utilities for assistance in meter selections and design requirements.
2. Provide conduit and wiring to power all 120 VAC control accessories such as flow meters. Feed this power from A DEDICATED 120V, 20 AMP CIRCUIT. Power connection for each device shall be installed with a lockable local service disconnect. Electrical power requirements to be coordinated with electrical drawings.
    a. Ethernet connection of Utility Meters to host computer. Connection to host computer via trunk connection to a communications closet, or local Ethernet data port, and as indicated on the drawings.
    b. Flow meter transmitters/displays shall be mounted not more than 5 feet above finished floor. They shall be located at the DDC panel array or other acceptable location within the maximum available cable length.
    c. Utilities metering cabling shall not be spliced.
    d. NOTE: ALL METER COMPONENTS, INCLUDING SENSORS, SHALL BE MOUNTED IN ACCESSIBLE LOCATIONS. ALL SERVICABLE POINTS SHALL HAVE ADEQUATE CLEARANCES FROM OBSTRUCTIONS AND SAFETY CONCERNS, ie. UNINSULATED STEAM LINES.
3. Wiring and Conduits:
    a. All wiring carrying voltages greater than 24 volts shall be run in conduit.
    b. All wiring carrying voltages 24 volts nominal or less shall be run in conduit.
    c. Conduits shall be sized on a maximum fill of 40% capacity.
    d. Three separate conduit systems shall be provided:
        a) DO/DI and AO/AI wiring.
        b) 120 VAC CONTROL WIRING.
        c) Ethernet communication

e. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.
f. All control wiring sizes and types shall meet the equipment manufacturer's recommendations.
g. All control wiring shall have insulation rated for 300 volts minimum, and be installed per NEC requirements.

C. Connections

1. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
2. Meters shall be installed with all necessary grounding components and gaskets per manufacturer’s instructions.
3. Connect flowmeter-system elements to meters.
4. Connect flowmeter transmitters to meters.
5. Ground equipment according to Division 26 Section "Grounding and Bonding."
6. Connect wiring according to Division 26 Section "Conductors and Cables."

D. Adjusting

1. Calibrate meters according to manufacturer's written instructions, after installation.
2. Adjust faces of meters and gages to proper angle for best visibility.

3.2 RTD

A. Installation

1. Installation location of building and plant (energy source) flow meters applications is identical.
2. Install RTDs in accordance with manufacturers recommendations for accurate temperature readings.
3. Install RTD as close as possible to common header leaving energy source.
4. Insertion depth is to be per manufacturers recommendations. Typical insertion depth is 1/3 of pipe diameter.

3.3 CONDENSATE RETURN UNITS

A. Examination

1. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.
2. Examine rough installation of steam condensate piping.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Installation

1. Install pumps according to Hydraulic Institute HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

2. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
3. Support pumps and piping separately so piping is not supported by pumps.
4. Install pumps on concrete bases. Anchor pumps to bases using inserts or anchor bolts.
5. Install thermometers and pressure gages on pump discharge piping.
6. Remote mount panel is to be installed in code compliant location. Reaching over condensate return unit to access panel is not acceptable.

C. Connections

1. Piping installation requirements are specified in other Division 20, 22, and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
2. Install piping adjacent to machine to allow service and maintenance.
3. Install check valve, isolation valve, and globe valve at pump discharge connections for each electric-driven pump.
4. Pipe drain to nearest floor drain for overflow and drain piping connections. Overflow shall have a water seal to prevent flash steam from venting through drain piping.
5. Install full-size vent piping to outdoors, terminating in 180-degree elbow at point above highest steam system connection or as indicated.
6. Ground equipment according to Division 26 Section "Grounding and Bonding."
7. Connect wiring according to Division 26 Section "Conductors and Cables."

D. Startup Service

1. Verify that steam condensate pumps are installed and connected according to the Contract Documents.
2. Complete installation and startup checks according to manufacturer's written instructions.
3. Clean strainers.
4. Set steam condensate pump controls for automatic start, stop, and alarm operation.
5. Perform the following preventive maintenance operations and checks before starting:
6. Set float switches to operate at proper levels.
7. Check motors for proper rotation.
8. Test pump controls and demonstrate compliance with requirements.
9. Replace damaged or malfunctioning pump controls and equipment.

3.4 VALVE INSTALLATION

A. General: Install valves such that operator is completely operable, and the valve position indicator is discernible from the floor.

B. When indicated on plans relocate position of the packing ports for access. (Not at 6 o’clock)

3.5 QUALITY ASSURANCE/ QUALITY CONTROL (QA/QC)

A. Perform QA/QC activities in accordance with Related Sections.

END OF SECTION 336333