

UTILITY DESIGN GUIDELINES

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I. Purpose and General

The intent of these design guidelines is to provide direction and guidance to design professionals regarding the University of New Mexico utilities systems and minimum expectations for the design of new and renovated service connections. No connection to the utility systems described herein can be made to any component of a proposed addition without the expressed written approval of the PPD Utilities Division. Designers and contractors should make every effort to assure that prior approval of proposed systems and components by the Utilities Division is obtained prior to construction of such elements.

Refer to addenda, standard details and specifications for additional information relating to individual utilities.

II. Domestic Water & Sewer

Part 1 - General

The domestic water system at UNM consists of wells and pumps, interconnections to the City of Albuquerque (COA) water system, a 1.2 million gallon storage reservoir, and 80 psig distribution piping. This guideline is intended to assist the designer in designing a new or renovated domestic water system that will be compatible with current or future connection to the UNM system.

The Main campus is served by an exterior direct buried loop system in the Redondo/Campus loop road. This system augments an older interior system which is distributed primarily in the UNM tunnel system. Best service is obtained by a direct connection to the exterior loop, but adequate service is generally available on the interior loop. The designer of a new or renovated building system should coordinate with the staff of the Physical Plant Utilities Division for the particulars of the specific domestic water assets in the vicinity of the project under design. The particular project location will determine if the project will need to be connected to the interior, exterior or COA systems.

The COA provides backup water supply to the campus system. The condition of the well or distribution system pumps is monitored at the Ford Utilities Center. The system can be switched manually or remotely to the COA system on a failure of the UNM facilities.

The system serves the North Campus with redundant piping in the utility tunnels. An exterior direct-buried loop has been started at the north end of the tunnel system. University of New Mexico Hospital (UNMH) is connected to both the UNM and COA systems, with UNM acting as backup.

The sanitary sewer system is provided through a private (university-owned) collection system connected to the City of Albuquerque Sanitary Sewer System.

Part 2 – Design Guidelines

Individual metering and cross-connection protection is required for each individual building. Intra-building cross-connection protection should follow ASPE cross-connection prevention guidelines. Building meters may be inside the building but must be accessible to maintenance personnel. Main backflow preventers shall be located inside the building. A reduced-pressure backflow device must be provided at every connection to the water system. Double check valves are not allowed.

Sanitary Sewer - Sanitary sewer service is provided through a private (university-owned) collection system connected to the City of Albuquerque Sanitary Sewer System. Design and installation should comply with the City of Albuquerque Standards. Buildings with separate lab waste systems should include a sampling manhole outside of the building prior to combination with the normal building waste stream.

III. Steam and Condensate

Part 1 – General

North/Central Campus Steam Distribution - Steam is generated and distributed at service pressures of 125 psig and 40 psig. Steam is available year round, but the pressures may vary up to 20% during peak loads. The low-pressure heating mains will normally maintain a minimum of 25 psig at the buildings; the pressure will vary depending upon demand. The most common building pressures are 40 psig and 15 psig.

Part 2 – Design Guidelines

The standard design manual for steam, water, and gas piping is the American Society of Plumbing Engineers Data Book and associated supplements. Planning and Campus Development has detailed location information on many underground utility sites. On-campus design professionals and Physical Plant personnel can provide further information on specific sites.

Documentation of designs should include detailed information on as-built existing conditions of distribution systems being connected to, and should provide the same level of detail on new installations. Profile drawings of new underground utilities are required, as are locations of existing utilities which may be disturbed or encountered during excavation. Designers are required to update drawings to reflect as-built conditions upon completion of construction.

All steam, condensate, and domestic water lines within the building envelope shall be insulated. Uninsulated mains or run-outs shall not be used as heat sources. Chases and stack areas carrying heating lines in the building should be adequately ventilated to prevent overheating due to piping losses.

All connections to mains shall be valved, both sides of the connection to the main and at the building.

All new piping shall conform to the color scheme cited in section 15075 or be stenciled with type of service and direction of flow.

The heating system should not be depended upon to provide process steam.

Piping and Connections - All new buildings must be provided with steam meters. Steam should be metered directly, unless specific prior approval from the PPD-UD is obtained for condensate metering. Condensate meters should be placed on the discharge side of the condensate pump. A three-valve bypass around meters should be provided. Where ever possible, steam and condensate piping shall be installed in such a manner as to allow for gravity return of condensate. The designer is to provide drip lines and air vents as needed to assure ease of operation. The project manager shall coordinate all connection of new services to the steam mains with PPD-UD personnel.

No connections to the steam mains shall be made without proper approval and inspection by PPD-UD. The building steam system shall not be energized without final inspection and approval of the PPD-UD, who shall operate all valves during start-up.

Steam reducing stations should configured in a 1/3 and 2/3 flow arrangement for both regulators and control valves

Campus Steam Distribution

- Exterior steam and condensate lines shall be installed, in order of preference, in fully accessible walkable concrete utility tunnels, semi-accessible pre-cast concrete tunnels, or shallow trenches.
- Pre-insulated direct buried piping systems will be reviewed on a case-by-case basis, typically for service from the main connection to the building. Carrier pipes will be separately cased. Multiple carrier pipes in a single casing shall not be used
- Expansion loops or accessible expansion joints shall be used for expansion compensation in shallow trenches. Expansion joints will be used in tunnels.
- Steam pipe shall be schedule 40 black steel pipe with 250 pound rated fittings in the distribution to the first pressure reducing station in the building. Steam piping shall be all welded construction.
- Condensate pipe shall be schedule 80 black steel pipe with schedule 80 fittings. Condensate piping shall be all welded construction to the first valve in the drip leg. Threaded fittings are permitted for use on the drip leg after the first valve.
- Ball Joints must be able to be re-packed. If installed in the vertical position, choose ball joints that have the male end pointed down.

- Strainers on the 125 psig system shall be 150 psig rated cast steel, 300lb flange rating, with a stainless steel standard screen.
- Hand Valves:
 - Shutoff service: Rising stem, steel forged gate valves are preferred.
 - Flow control service: globe valves are preferred

Drip Legs and Steam Traps

- Inverted bucket or thermodynamic F&T traps shall be specified for use on drip legs.
- Each trap will be sized based on the amount of condensate calculated for the distribution.
- High-pressure condensate from the drip legs shall not be directly introduced to the pumped wet condensate return system.
- Stainless steel spring checks are to be used on the condensate return system.
- Threaded steel forged valves are to be used on steam trap assemblies.
- No copper piping or checks with Teflon seats are authorized on steam trap assemblies.

Insulation

- Insulation material on steam and condensate piping in tunnels shall be calcium silicate. Insulation thickness shall be as required by the latest ASHRAE Standard for buildings, but applied to utility construction.
- Insulation shall be provided on all piping, flanges, valves, etc. to reduce heat gain in the tunnels.
- Aluminum jacket shall be used in tunnels and plants on all piping, fittings, etc. Aluminum jacket shall be provided on valve bodies up to the flanges for the gland packing to allow for service of the gland.
- Use 30-pound asphalt-impregnated felt jacket or other suitable material to protect insulation of pipes in concealed spaces from abuse during construction and from future deterioration. In high traffic areas, where insulated pipes are subject to mechanical abuse, metal covering or structural protection shall be provided. Wire used for securing pipe coverings shall be solid copper, stainless steel, or other non-ferrous material with a long service life.

Materials

Table 1: Low Pressure Piping Materials Schedule

Item	Size	Description
Piping	All sizes	Seamless sch-80 – Carbon Steel Pipe
Piping	All sizes	150 psig – Design Pressure
Piping	All sizes	550 °F – Design Temperature
Piping	All sizes	225 psig – Hydrostatic Test Pressure
Fittings	2" and under	Malleable steel - screwed or welded
Fittings	2 1/2" and over	Malleable steel – welded
Flanges	All sizes	300 lb. raised face
Bolting	All sizes	Alloy steel ASTM A193 grade B7 bolts and studs with A194 grade 2H nuts
Unions	2" and under	300 lb., raised face, SW, integral SS seat
Gaskets	All sizes	300 lb., 3/16" thick, spiral wound with 1/8" thick outer guide ring, 304 SS with Verdicarb Filler
Take-off	2" & under main 2" & under branch	Socket weld tees
Take-off	2½" & over main 2" & under branch	Reducing tee forged steel sock-o-let
Take-off	2½" & over main 2½" & over branch	Equal or reducing tee, nozzle weld with reinforcing as required, forged steel weld-o-lets

Table 2: High Pressure Piping Materials Schedule

Item	Size	Description
Piping	All sizes	Seamless sch-80 – Carbon Steel Pipe
Piping	All sizes	150 psig – Design Pressure
Piping	All sizes	550 °F – Design Temperature
Piping	All sizes	300 psig – Hydrostatic Test Pressure
Fittings	2" and under	Malleable steel - screwed or welded
Fittings	2 1/2" and over	Malleable steel – welded
Flanges	All sizes	300 lb. raised face
Bolting	All sizes	Alloy steel ASTM A193 grade B7 bolts and studs with A194 grade 2H nuts
Unions	2" and under	300 lb., raised face, SW, integral SS seat
Gaskets	All sizes	300 lb., 3/16" thick, spiral wound with 1/8" thick outer guide ring, 304 SS with Verdicarb Filler
Take-off	2" & under main 2" & under branch	Socket weld tees
Take-off	2½" & over main 2" & under branch	Reducing tee forged steel sock-o-let
Take-off	2½" & over main 2½" & over branch	Equal or reducing tee, nozzle weld with reinforcing as required, forged steel weld-o-lets

Table 3: Condensate Piping Materials Schedule

Item	Size	Description
CR Pipe	All sizes	Seamless sch-80 – Carbon steel
CP Pipe	All sizes	Seamless sch-40 – Carbon steel
Piping	All sizes	Design Pressure - 100 psig Design Temperature - 220 °F Hydrostatic Test Pressure - 150 psig
Fittings	All sizes	Malleable steel – screwed or welded
Unions	2" and under	300 lb., raised face, screwed, integral SS seat

IV. Chilled Water

PART 1 - General

- 1.1 The central chilled water systems at UNM consist of direct pumped primary chilled water distribution piping from central plants and limited stand alone building chillers. This guideline is intended to assist the designer in designing a new or renovated building system that will be compatible with current or future connection to the UNM district cooling system.
- 1.2 The designer of a new or renovated building system should coordinate with the staff of the Physical Plant Utilities Division for the particulars of the specific chilled water assets in the vicinity of the project under design. The particular project location will determine if the project will provide a building chiller or connect to existing chilled water distribution piping.
 1. **Specific Design Information:** The actual pressures within the campus-wide system at a specific building/site at any given time depends upon that building's location along the distribution system, the weather conditions, the time of year as well as the time of day. Information related to the projected availability of chiller plant capacity, distribution system capacity and system pressures can be obtained on request to the PPD-UD which uses a software system simulation utilizing real-time and historical system data.
- 1.3 Central chilled water will be operated year round with a supply temperature of 42 °F in the summer, 50 °F in the winter.
- 1.4 Each building will use a direct connection to the district cooling system without the use of building pumps. The building coils shall be controlled at the coil air discharge such that the temperature rise shall not be less than 16 °F with the supply temperatures given in 1.3.
- 1.5 Pumps and plate heat exchangers will only be allowed for buildings with height restrictions that would prevent filling the system completely from the district cooling system.

PART 2 - Design Guidelines

2.1 General

- The designer's goal should be to design a building system that can function as closely as possible as a variable flow, constant temperature rise system over the entire load range for all seasons.

- Design pressure for all components should be at least 250 psig at 100°F.
- Design fill pressure shall be 40 psig.
- Pipe all system drains to sanitary sewer. Provide brass hose adapter, cap and chain on all vents and drains.

2.2 Coils

- All chilled water coils shall be selected on the basis of 42° F summer, 50° F winter entering water temperatures and 58° F leaving water temperature. Minimum tube velocity shall be 4 fps at full load condition. Select coils to maintain a 16 °F ΔT from 100% load down to 25 % part load.
- Specify two way control valves for all coils and provide variable flow loop for the building or process loop. All control valves and operators shall be selected for the full possible pump head on the loop. Control valves shall be in accordance with the HVAC controls design guideline.
- All coils shall have non-ferrous headers and tubing.

2.3 Direct Buried Piping System

- General: All underground piping for chilled water system distribution shall have a minimum diameter of 4" and shall be cement lined ductile iron.
- Pipe Restraint: All distribution piping should be fully mechanically restrained, requiring no thrust blocking.
- Ductile Iron Pipe: Pipe shall conform to AWWA C151 minimum class 50. All ductile iron pipe shall be cement mortar lined in accordance with AWWA C104 and shall have asphaltic coating. Piping 4" – 12" shall have 350 psig minimum working pressure. Piping 14" – 24" shall have a 300 psig minimum working pressure.
- Select backfill material shall be provided for bedding and backfill 12" above pipe.
- System drains and vents – Provide system drains at low points and system vents at high points.
- Fittings: Fittings for ductile iron pipe shall be ductile iron and rated a minimum of 250 psi working pressure. Fittings shall be cement mortar lined equivalent to the pipe lining.
- Mechanical Joint Fittings: Comply with AWWA C110. Where restrained joints are identified, use Megalug Series 1100 system or approved equal. Gasket material shall be SBR
- Push-on Joint: Comply with AWWA C111
- Butterfly Valves: Comply with AWWA C504. Valve shaft to be type 304 stainless steel. Cast valves from gray or ductile iron. Provide interior coating of body and disk. Valves shall be furnished with buried service gearbox operator, shaft extensions, ground level position indicators and valve boxes.

- Gate Valves: Comply with AWWA C509. Stem shall be non-rising and shall be cast bronze. Valve body and wedge shall be ductile iron and shall be coated inside and outside with epoxy. The coating shall meet or exceed AWWA C550. Valves shall have a minimum pressure rating of 250 psi. Gate valves shall be US pipe or approved equal.
- Valve Boxes: Valve boxes shall be 2 piece cast iron with heavy duty traffic weight lid marked with valve number as shown on drawings (such as CWS – 22). Valve boxes not in paving shall be supplied with a pre-cast concrete mowing ring.

2.4 System Pressure and Leak Test

- Length of test, unless otherwise approved, shall be a minimum of 4 hours. Contractor shall have conducted a preliminary pressure test prior to final acceptance test to locate and correct any pipe leaks.
- Chilled water piping shall be leakage rate tested. Leakage rate test shall be conducted at the same time as the hydrostatic pressure test. Leakage rate is defined as the quantity of water that must be supplied into respective underground piping system to maintain pressure within 5 psig of the specified hydrostatic test pressure after system has been vented and filled. Contractor shall document test results and sign/date each test.

- The maximum allowable leakage is determined by the following formula:

$$L = N * D * (P)^{1/2} / 7,400$$

where:

L = allowable leakage (GPH)

N = number of joints in length of pipe line tested

D = nominal pipe diameter (inches)

P = average test pressure during leakage test (psig)

- If measured leakage rate exceeds maximum leakage rate, repair with new materials and repeat test until satisfactory results have been obtained.

2.5 Control Logic

- The discharge air leaving each building coil shall be maintained at the design temperature
- Additional logic assuring leaving chilled water temperature of no less than 58 °F without compromising building cooling capacity is encouraged.

2.6 Building Service Entry

- Each building shall include as a minimum, shutoff valves, temperature and pressure gauges, system drains and metering in accordance with metering guideline.

2.7 Accessible Distribution System Piping

- Piping in accessible tunnels and mechanical spaces shall be schedule 40, black steel pipe.

V. Electric Generation and Distribution

Part 1 – General

The electrical systems at UNM consist of electrical production facilities, paralleling interconnections to Public Service Company of New Mexico (PNM), and distribution on 12.47 KV primary selective dual radial distribution system. This guideline is intended to assist the designer in designing a new or renovated electrical system that will be compatible with current or future connection to the UNM distribution system.

UNM owns the substations that serve the Main and North campuses. The substations receive power from PNM at 115 KV and transform it to 12.47 KV for campus distribution. The substations are interconnected on the secondary side to provide redundant transformer capabilities.

Part 2 – Design Guidelines

The designer of a new or renovated building system should coordinate with the staff of the Physical Plant Utilities Division for the particulars of the specific electrical assets in the vicinity of the project under design. The particular project location will determine if the project will need to be connected to the local utility or to the UNM electrical system. UNM prefers to own, rather than lease, the facility transformer when connected to PNM.

Electrical power is provided to the UNM Main and North campuses from the UNM-owned substations at 12,470 volts on a primary selective, dual radial distribution system.

The system consists of two 500 MCM, 15 KV circuits distributed in buried ductbank to facilities on two switched “A” and “B” radials.

Facilities are served from the system utilizing one to four SF6 vacuum breakers which feed the facility transformer(s).

Portions of an older 115 KV / 4160 V distribution still exist on the Main Campus. The designer should coordinate with the staff of the Physical Plant Utilities Division for the particulars of the existing system. In general, no new connections to the 4160 V system will be allowed.

The university is the principal provider of electric power throughout the campuses. Some facilities, located on the perimeter of existing infrastructure systems, may be served directly by Public Service Company of New Mexico (PNM). The designer must include provisions for underground duct bank, manholes, pad-mounted transformers, switching devices, cables and standby generation to be included in the construction. The university will operate and maintain the switches and transformers but this equipment must be provided by the project. In addition, the switches and transformers must comply with the university specifications. See Appendix A - Division 16 - Electrical specifications for additional information.

The Main and North campus electrical system is monitored at the Ford Utilities Center through a Rockwell Power Management System. The system monitors power flows throughout the system and is capable of shedding load on an upset event. All new electrical facilities shall have relays and equipment compatible with the system to allow the equipment to be remotely operated.

VI. Natural Gas

Part 1 – General

Limited natural gas service is available at 5 psig throughout most of the North and Main campuses from a UNM-owned distribution system in the tunnels.

Natural gas is also available on the North and South campuses directly from local utility company lines. Metering and lateral piping into each new building should be included in the contract.

Part 2 – Design Guidelines

Gas Distribution Piping - Any gas distribution network must include a pressure-reducing station that is valved on both sides. All gas meters should be located on the outside of the building. A 3-valve bypass piping arrangement should be supplied around the meter

VII. Telecommunications and Data

The university is the primary provider of voice and data services throughout the Campuses. The designer must include provisions for raceways, wiring, and patch panels to be included in the construction. Separate guidelines are available from the UNM ITS Department. In general, no communications or data services are to be run in the tunnels.

VIII. Identification of Underground Utilities and Piping

Part 1 - General

All underground piping and utilities (both metallic and non-metallic), except lawn irrigation lines, shall have two stages of identification and/or warning by a combination of non-detectable and detectable warning tapes.

Part 2 – Design Guidelines

Identification Tape (non-detectable warning tape)

The 1st stage of identification shall be a buried non-detectable warning tape. This tape shall provide an early warning at shallow depth excavation. The tape shall be 6" wide, and buried approximately 18" to 30" above the service pipe, but a minimum of 10" below finished grade. It shall consist of multiple layers of polyethylene with an overall thickness of 3 to 5 mils. It shall be installed continuous from valve box to valve box or manhole to manhole, and shall terminate just outside of valve box or manhole wall. The black colored lettering on the warning tape shall be abrasion resistant and be imprinted on a color-coded background that conforms to APWA color code standards.

Warning Tape (detectable warning tape)

The 2nd stage of identification shall be a detectable warning tape. This tape shall provide pipeline identification, be fully detectable from above grade utility locators, and be able to provide a depth reference point to top of pipe. It shall be 6" wide, installed directly on top of the pipeline and permanently secured to the pipeline at 10' intervals. The tape shall consist of aluminum foil core or stainless steel tracer wires laminated between multiple layers of polyethylene tape with an overall thickness of 4 to 6 mils. Detectable core or tracer wire "circuit" shall be continuous from valve box to valve box or manhole to manhole for complete pipeline detection and location. Tape manufacturers' approved splice kits shall be used for long runs. Warning tape shall terminate just inside of valve box cover or manhole ring cover and be easily accessible for "clip-on" type utility location meters. The black colored lettering on the warning tape shall be abrasion resistant and be imprinted on a color-coded background that conforms to APWA color code standards.

Tracer Wire

All non-metallic pipe, including lawn irrigation lines, and metallic pipe with compression gasket fittings installed underground shall have a tracer wire installed along the length of the pipe. The wire shall be taped to the bottom of the pipe at a maximum of 10' intervals and not allowed to "float freely" within the backfill. Tracer wire shall be single-conductor, 10

gauge minimum, copper single-conductor wire with type "UF" (Underground Feeder) insulation, and shall be continuous along the pipeline passing through the inside of each valve box.

IX. Metering

Overview

The University of New Mexico Physical Plant Utilities Division (PPD-UD) manages and operates a District Energy System (DES) on the Main and North Campuses that provides the utilities listed in 2.1B below. PPD-UD requires that any facility that connects to at least one of these DES utilities be provided with whole facility instrumentation and metering devices meeting this guideline sufficient to determine the consumption of the various utilities connected to the facility. Facilities that do not connect to the DES utilities may be required to meet this guideline based on the project scope and program.

The Energy Metering System (EMS) is a networked metering, monitoring, and verification system comprised of facility hardware, facility software, network equipment, EMS servers, and EMS software. This guideline includes the facility hardware and software, but the project budget must fund all components of installation including hardware, software, commissioning, and installation provided by PPD-UD. PPD-UD will provide the project manager with estimates of the cost of those items provided and installed by PPD-UD.

The facility is instrumented locally for each of the DES utilities to which it is connected. The instruments are wired to a Building Utilities Metering Panel (BUMP) provided by PPD-UD. This panel contains a programmable logic controller and other hardware necessary to provide and display continuous historical and instantaneous metering of the facility. The BUMP reports data over the campus WAN on a secured network to the remote EMS servers where it is stored for management information and reporting purposes. The contractor(s) who provide the utility metering for the facility are required to coordinate with the PPD-UD personnel and contractors to assure a complete working system.

The system also provides a backbone for reporting and operation of the facility Direct Digital Control System (DDCS) which is described in other guideline(s).

PART 3 - GENERAL

3.1 SECTION INCLUDES

- A. This document covers the metering guidelines for typical UNM facility utility metering.
- B. The facility utilities to be metered are:
 - 1. Chilled Water
 - 2. Steam
 - 3. Condensate
 - 4. Natural Gas
 - 5. Domestic Water
 - 6. Electric

PART 2 EQUIPMENT

2.1 GENERAL REQUIREMENTS

- A. The exact location and arrangement of pipe upstream and downstream of the flow sensors shall be based on the manufacturer's recommendations, requirements, and specifications.
- B. Typical operating range design Information is as follows:
 - 1. Chilled Water
 - a. Temperature Range: 35-100 degree F
 - b. Pressure Range: 20-80 psig
 - 2. Steam
 - a. Temperature Range: 100-350 degree F
 - b. Pressure Range: 0-150 psig
 - 3. Condensate
 - a. Temperature Range: 100-350 degree F
 - b. Pressure Range: 0-50 psig
 - 4. Natural Gas
 - a. Pressure Range: 0-20 psig
 - 5. Domestic Water
 - a. Pressure Range: 0-100 psig
 - 6. Electric: as required by the building design, but generally transformed from primary 12.47 KV or 4160 V to 208/3p/4W or 480/3p/4W.
- C. All transmitters shall have the following characteristics with no exception (unless otherwise indicated within this guideline)
 - 1. Input power 24VDC
 - 2. Output Signal: 4-20mA
- D. Each instrument shall be labeled with a brass tag secured to the instrument indicating calibration range, building number, and service
- E. Calibration label on instrument shall indicate last factory calibration date.
- F. All instrumentation shall be calibrated using local barometric pressure.
- G. Each instrument shall have a local readout installed in an easily accessible location irrespective of the actual instrument location.
 - 1. Each instrument shall transmit both instantaneous (4-20ma) and totalization signals (pulse). Instantaneous and totalization values will be displayed on the local readout.
- H. All in-line meters will be installed with a full size bypass with isolation valves on either side of the meter and one on the bypass.
- I. All instrumentation shall be rated to operate in an ambient temperature of 32 - 185 degrees F and calibrated for an altitude of 5200'.
- J. All transmitter enclosures shall be rated at a minimum of NEMA 4 with a minimum of two ¾" electrical hubs with plugs.
- K. All instrumentation shall be Hart-compatible.

2.2 CHILLED WATER METER FLOW METER AND TRANSMITTER

- A. Flow sensor and transmitter shall be Foxboro or prior approved equivalent meeting the following:
- B. Flow sensor shall be corrected mass-flow, flanged in-line “magpipe” electromagnetic technology.
- C. Maximum pressure drop across meter assembly at maximum design flow: 1.0 psi.
- D. Accuracy: $\pm 1.0\%$ of flow across full range for given pipe size.
- E. Minimum turndown ratio: 100:1.

2.3 STEAM METER FLOW SENSOR AND TRANSMITTER

- A. Flow sensor and transmitter shall be Foxboro or prior approved equivalent meeting the following:
- B. Flow sensor shall be capable of mass flow (corrected for temperature and pressure), flanged in-line vortex-shedding technology, but shall be calibrated for volumetric flow (mass flow conversion and correction occurs in the BUMP).
- C. Maximum pressure drop across reduced-size meter assembly at maximum design flow: 5.0 psi.
- D. Accuracy: $\pm 1.0\%$ of flow across full range for given pipe size.
- E. Minimum turndown ratio: 100:1.
- F. Flow Sensor Material: 316 Stainless Steel.
- G. Flanges and piping shall be of Class (generally 150 or 300) and Schedule (generally 40 or 80) matching that of the piping in which it is installed.

2.4 DOMESTIC WATER METER AND TRANSMITTER

- H. Flow sensor and transmitter shall be Turbo Badger Meter or prior approved equivalent meeting the following
- I. Flow sensor shall be in-line turbine type flow meter.
- J. Maximum pressure drop across reduced-size meter assembly at maximum design flow: 1.8 psi.
- K. Accuracy: $\pm 1.5\%$ of flow across full range for given pipe size.

- L. The housing will be cast bronze with all internal pieces made of durable material such as thermoplastic or stainless steel. All bearings shall be self-lubricating.
- M. The domestic water meter will be provided with a strainer on the utility side of the meter. The strainer will be installed so as to allow ease of maintenance.

2.5 NATURAL GAS METER

- A. Flow sensor and transmitter shall be American Meter Company or prior approved equivalent meeting the following
- B. Flow sensor shall be in-line diaphragm type flow meter.
- C. Maximum pressure drop across reduced-size meter assembly at maximum design flow of 2" W.G..
- D. Accuracy: $\pm 1.0\%$ of flow across full range for given pipe size.
- E. The housing will be die-cast aluminum case. All bearings shall be oil-impregnated self-lubricating bearings. All seals shall be long-life grommet seals. The housing and all parts will be rated for outdoor.

2.6 ELECTRIC METER

- A. Meter shall be a Shark 200 with Ethernet card or prior approved equivalent meeting the following
- B. Electrical meter shall be installed in the main electrical distribution panelboard with local scrollable display.
 - 1. Where required by the project, additional submetering may be necessary on building branch circuits. All such meters shall meet this guideline.
- C. The meter shall be capable of measuring current and voltage on all phases including neutral. Meter shall be rated for 60 Hz power.
- D. All shorting blocks will be provided with the meter. Shorting blocks shall be capable of being remotely located within the electrical equipment.
- E. The meter will be provided with matching CT's and any required PT's for a complete installation. All CT's will be removable for ease of maintenance.
- F. Accuracy: $\pm .075\%$ of full-scale reading.
- G. Meter sampling will be zero blind rate 128 samples/cycle.
- H. Meter shall be able to provide up to 63rd harmonic content of current.
- I. Meter shall be able to provide waveform capture of a minimum of 3 cycles at 128 samples/cycle.

- J. The meter will have the following data capable of being transmitted to an Ethernet switch via the Ethernet card:
 - 1. All Phase Currents (A, B, C, N in Amps)
 - 2. All Phase-Phase and Phase-Neutral Voltages (in Volts)
 - 3. KW Demand (KW)
 - 4. Accumulated Power (Megawatt-hours)
 - 5. Harmonic Content, (A, B, C, N in Percent)

- K. Meter will have the following alarm capable of being transmitted to the Ethernet switch
 - 1. All Phase Faults (A, B and C)
 - 2. All Phase Voltage spikes
 - 3. Meter General Alarm

- L. Meter shall comply with UL 508.

- M. Output communication of the meter shall be Modbus over IP via the Ethernet card.

- N. The electric meter does not directly connect to the BUMP. Rather it connects to the Ethernet switch via Cat 5/6 cable (to match the building standard).
 - 1. The Ethernet switch is that for the PPD Utilities VPN, usually located in a UNM-IT wiring closet (TR). Depending on equipment locations the Ethernet switch within the BUMP may be used instead.

- O. Solar PV system metering
 - 1. Solar PV systems will have a submeter matching the electric meter specifications.
 - 2. In addition, solar PV systems will be equipped with an Egauge 3 series meter with an independent Ethernet connection to the nearest TR.

2.7 TEMPERATURE SENSOR, TRANSMITTER AND WELL

- A. Sensor, well and transmitter shall be Rosemount, Foxboro, or prior approved equivalent.

- B. Temperature sensor shall be well type 3-wire, platinum, 1000 ohm RTD.

- C. The sensor shall include well. Temperature wells shall be constructed of Type 304 stainless steel to the proper depth, with $\frac{3}{4}$ " NPT pipe connections, and extension neck for insulated lines. Wells shall be furnished with screw plug attached to wells with chain to keep dirt out when not in use. $\frac{3}{4}$ " thread-o-lets shall be welded to the pipe to receive wells.

- D. Accuracy: $\pm 0.075\%$ of calibrated span.

- E. Minimum Update Rate: 20 times per second.

- F. Individual well type temperature sensors and transmitters will be provided for:
 - 1. Chilled Water Return
 - 2. Chilled Water Supply
 - 3. Steam
 - 4. Condensate

2.8 PRESSURE SENSOR AND TRANSMITTER

- A. Sensor and transmitter shall be Foxboro.

- B. Accuracy: $\pm 0.075\%$ of calibrated span.
- C. Minimum Update Rate: 20 times per second.
- D. Meet NFPA 70 501-5.
- E. Pressure assembly shall include appropriate tap, stop valve, snubber, and block and bleed valve along with sensor.
- G. Individual pressure sensors and transmitters will be provided for:
 - 1. Chilled Water Return
 - 2. Chilled Water Supply
 - 3. Steam

2.9 BUILDING UTILITY METERING PANEL CONNECTION REQUIREMENTS

- A. Provide a separate 120VAC, 20 A, GFCI, isolated, surge-suppressed emergency-powered circuit for BUMP and auxiliary panel power.
- B. Provide a UNM network connection from the ITS closet to the BUMP.

2.10 NETWORK EQUIPMENT AND RACKS

- A. Provide sufficient space and power in the ITS network closet racks for the VPN firewall and FieldServer devices.
- B. Provide location and power for auxiliary panel in ITS closet.

PART 3 – EXECUTION

3.1 BUMP INSTALLATION:

- A. All terminations shall be wired and installed in separated gutter located above the designated BUMP location meeting the facility construction specifications for combined power and instrumentation wiring. The building contractor shall leave six (6) feet of coiled wire for each termination.
- B. All wiring shall be color-coded and tagged with sufficient information to determine the instrument to which it is connected.
- C. When so notified by the project manager that the installation is complete, and it is safe for the BUMP to be installed, PPD-UD shall provide and install the BUMP.
- D. The contractor shall coordinate, cooperate, and provide all necessary assistance during the commissioning and startup of the facility metering system by PPD-UD.
- E. Although not necessarily part of the contractor's scope, the project must also coordinate, cooperate, and provide all necessary assistance during the integration, commissioning and startup of the facility metering system connection to the campus EMS.

3.2.1 APPROVALS

- A. PPD Utilities Division must approve all drawings and specifications at each design stage in writing before proceeding to the next stage of design. Approval of the building design stage does not imply approval of the metering system design.

Prior approvals for equipment not specifically mentioned in this guideline must be approved by the PPD Utilities Division at least fourteen (14) days prior to bid. In order for the approval request to be reviewed, the supplier of the proposed equipment must include model number, full specifications, performance, cut sheets, and all necessary information that unambiguously shows that the proposed equipment meets the full requirements of this guideline. The supplier must also show conclusively that the equipment will communicate properly with the BUMP, either by demonstration or proof that such equipment has performed as required by this guideline in equivalent installations. The determination of equivalence and approval is by the PPD-UD whose decision shall be final. If the equipment is approved, it will be added by name, manufacturer, and model number as acceptable for future projects.