

PART III – CSU FACILITIES PLANNING, DESIGN AND CONSTRUCTION STANDARDS

DIVISION 33 – UTILITIES

Please also refer to “Part IV – REGULATORY REQUIREMENTS” for additional requirements.

Housing and Dining Facilities (HDS) has adopted amendments for all HDS facilities. Confirm applicable standards with Project Representative on a per Project basis. Refer to HDS amendments here – <https://housing.colostate.edu/about/construction/>.

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33 00 00 – GENERAL INFORMATION

- A. The University owns most of the Utility Distribution Systems on its campuses.
- B. New buildings shall connect to University–owned utilities unless approved Facilities Management (FM) Utility Services.
- C. Consult with FM Utility Services through the Project Representative for questions and clarifications.
- D. The following process applies to the water, sanitary sewer, stormwater, natural gas, chilled water, and steam utilities, and shall be followed during the Project’s procurement, design, and construction phases:
 - 1. Preliminary meeting:
 - a. There shall be a preliminary meeting between designers and FM Utility Services to establish needs for the Project, and how the Project shall integrate into the Campus Utility Systems or the Systems of outside providers.
 - b. Preliminary routes shall be established at this time.
 - 2. Design:
 - a. During the design phase, designers shall provide estimated loads for the relevant utilities.
 - b. The new loads shall be modeled within the existing Systems by Utilities Services.
 - c. Necessary scope shall be identified to accommodate the loads.
 - d. Routes and elevations shall be established.
 - e. FM Utility Services reserves sole authority in utility routing on University property.
 - 3. Review and Acceptance:
 - a. The completed Construction Documents shall be submitted to FM Utility Services for review and comment.
 - b. Documents shall include plans, Specifications, and drainage reports.
 - c. When all comments have been satisfied, FM Utility Services shall approve the Documents.
 - d. Construction shall not commence until the approval is received.
 - e. FM Utility Services reserves sole approval authority.
- E. The following process applies to the electric utility, and shall be followed during Project procurement, design, and construction phases:
 - 1. FM Engineering shall design all electric primary utilities.
 - 2. Unless otherwise stated during the Request for Proposal (RFP) and/or pre–design conference, FM shall furnish and install primary duct bank, vaults, 15kV sectionalizing switches, 15kV cable, transformer and transformer pad.
 - 3. FM Utility Services reserves sole authority to delegate all or part of the electric utility scope stated above.

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- F. If coordination with outside utility providers (e.g. City of Fort Collins Utilities, Xcel Energy, ditch companies, or telecom companies) is necessary during the design or construction of a Project, coordination shall be done through FM Utility Services.
- G. All incoming utilities shall have proper means for building service isolation both at utility mains and immediately after entering the building.
- H. Provide tubing or pipe (not sheet metal) sleeves for all utility services passing through structural walls and slabs.
 - 1. All sleeves passing through slab floors shall project a minimum of 4” above the slab and shall be sealed water tight to the slab.
 - 2. Sleeve shall be filled with a flexible, gas-tight sealant.
- I. Excavations shall conform to Division 31 – Earthwork.
- J. Backfill for all utilities shall conform to requirements described in Division 32 – Exterior Improvements.
- K. Colorado State University (CSU) maintains its own Advanced Metering Infrastructure (AMI) for the electric, water and gas utilities.
 - 1. This smart metering network is a 900MHz wireless mesh network using Elster devices such as gatekeepers, repeaters and meters.
 - 2. All electric, water, and gas utility meters shall connect to this System.
 - a. Refer to information below for specific requirements.
- L. CSU maintains a LAN network for chilled water and steam utility meter communication.
 - 1. All chilled water and steam meters shall connect to this network.
 - a. Refer to information below for specific requirements.

33 05 00 – COMMON WORK RESULTS FOR UTILITIES

A. Trenchless Installation:

- 1. Directional Boring
- 2. Jack Boring
- 3. Pipe Bursting

B. Tracer Wire:

- 1. Acceptable Products:
 - a. Direct bury application:
 - i. Copperhead SuperFlexCCS with HDPE 30 mil insulation
 - ii. Or approved equal
 - b. Directional bore application:
 - i. Copperhead SoloShot EHS-CCS HDPE 45 mil
 - ii. Or approved equal
 - c. Connectors:
 - i. Copperhead SnakeBite and 3M DBR moisture displacement

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- ii. Or approved equal
 - d. Grounding Rods:
 - i. Copperhead ANO–14 magnesium drive–in anode
 - ii. Or approved equal
- 2. Products not Allowed:
 - a. Any THHN wire
- 3. Discussion:
 - a. All new utility lines outside the building foundation shall include a tracer wire, centered and secured to the top of the pipe or conduit to indicate the utility's location to tracing equipment.
 - b. Tracer wire must be exposed at either end of the utility above grade and be prominently marked in a tracer wire box after backfill is completed.
 - c. The Project Representative and FM Utility Inspector shall coordinate with the Contractor to determine the appropriate point and method of termination for the tracer wire (e.g. grounding rod, box), as field conditions shall vary.
 - d. The Utility Inspector shall also determine if this requirement shall apply to certain lines of new irrigation installations.
 - e. Tracer wires shall not be twisted together and wrapped with electrical tape. Corrosion shall occur over time and the locate signal shall be lost to ground at the connection.
 - f. Insulation color shall meet the APWA color code standard for identification of buried utilities.

C. Utility Line Signs, Markers, and Flags:

- 1. Marker posts should be similar to Carsonite CRM–375 with reflective labels.
- 2. The Utility Inspector shall determine on a case by case basis if marker posts are needed.

33 08 00 – COMMISSIONING OF UTILITIES

A. General Information:

- 1. Inspections are required on all underground utility installations.
 - a. Coordinate site inspections with the Utility Inspector by contacting the Project Representative at least 48 hours in advance.
 - b. Utility installations shall be completely visible for inspection.
 - i. For example, no backfill over piping, valves unwrapped so that joints are visible, etc.
 - c. Any installation not visible at time of inspection shall be made visible.
 - i. This means that if backfill has taken place, backfill shall be removed for inspection.
 - d. Piping that will be directionally bored shall be inspected before boring operations take place.
 - e. Backfill may take place after receiving Utility Inspector approval.
- 2. A part of the inspection process is the GPS cataloging of all underground utility installations for mapping purposes.
 - a. GPS location shall be performed by FM personnel and shall be coordinated through the Utility Inspector.
 - b. GPS location must be done before backfill.
 - c. GPS location by FM is not a substitute for thorough and accurate As–Built Drawings.

B. Commissioning of Water Utilities:

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1. If a water main cannot be isolated or if it is required to minimize time that customers are without water, the new pipe, fittings, and valves required for a connection shall be spray-disinfected or swabbed with a minimum of 1% Hypochlorite solution.
2. Great care shall be taken to prevent dirt, water, and debris from entering water piping during construction, both inside and outside the trench.
3. All new fire hydrants shall have pressure and flow tests.
 - a. Test results must meet the University's minimum level of acceptance.
 - b. Coordinate the hydrant test and testing requirements with the Utility Inspector.

C. Commissioning of Sanitary Sewer Utilities:

1. Sanitary manholes shall be vacuum tested before the ring and cover and grade adjustment rings are installed, and after backfill and compaction are complete.
 - a. The Contractor shall provide all equipment and personnel to perform the test.
 - b. Coordinate the vacuum test and testing requirements with the Utility Inspector.
2. All new sanitary piping shall be cleaned and televised at the completion of testing and before the lines are placed into service.

D. Commissioning of Storm Drainage Utilities:

1. A low-pressure air test shall be conducted on stormwater pipelines.
 - a. The Contractor shall provide all equipment and personnel to perform the test.
 - b. Coordinate the pressure test and testing requirements with the Utility Inspector.
2. Stormwater manholes shall be vacuum tested before the ring and cover and grade adjustment rings are installed, and after backfill and compaction are complete.
 - a. The Contractor shall provide all equipment and personnel to perform the test.
 - b. Coordinate the vacuum test and testing requirements with the Utility Inspector.
3. If the tests disclose leakage greater than the maximum allowed, the defective materials and joints shall be located and repaired.
 - a. The tests shall be repeated until the leakage is less than the maximum allowed.
4. At the end of the Project, all stormwater piping, including both new piping installed during the Project as well as piping downstream of the new connections to a point defined by the Utility Inspector, shall be cleaned and televised.
 - a. No soil or debris shall be flushed out of dirty lines and into the System.

E. Commissioning of Natural Gas Utilities:

1. A pneumatic pressure test shall be conducted on all new gas piping.
 - a. The Contractor shall provide all equipment and personnel to perform the test.
 - b. Coordinate the pressure test and testing requirements with the Utility Inspector.
2. If the tests disclose leakage greater than the maximum allowed, the defective materials and joints shall be located and repaired.
 - a. The tests shall be repeated until the leakage is less than the maximum allowed.
3. At the Utility Inspector's discretion, some gas piping shall be required to be pigged.
 - a. The intention is to eliminate any water that entered the piping during construction.

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F. Commissioning of Chilled Water Utilities:

1. All new piping shall be cleaned before filling.
 - a. Chilled water piping installations exceeding 100' in overall length shall be cleaned by circulating through progressive filtration until a 50 micron filter is clean after 24 hours.
 - b. Circulation flow rate in the piping installation during cleaning shall be a minimum of 3.5 feet per second in the largest pipe to keep silt and particles in suspension.
 - c. Side-stream filtration in combination with a fine mesh strainer at pump is acceptable.
2. A hydrostatic pressure test shall be conducted on all new chilled water piping.
 - a. The Contractor shall provide all equipment and personnel to perform the hydrostatic test.
 - b. Coordinate the pressure test and testing requirements with the Utility Inspector.
3. If the tests disclose leakage greater than the maximum allowed, the defective materials and joints shall be located and repaired.
 - a. The tests shall be repeated until the leakage is less than the maximum allowed.

G. Commissioning of Heating Water Utilities:

1. Coordinate details for testing and commissioning requirements with the Utility Inspector.

H. Commissioning of Steam Utilities:

1. All new piping shall be thoroughly blown out with steam to remove dirt, rust, scale or other contaminants.
2. A pneumatic pressure test shall be conducted on all new steam and condensate carrier piping as well as conduit piping.
 - a. The Contractor shall provide all equipment and personnel to perform the hydrostatic test.
 - b. Coordinate the pressure test and testing requirements with the Utility Inspector.
3. If the tests disclose leakage greater than the maximum allowed, the defective materials and joints shall be located and repaired.
 - a. The tests shall be repeated until the leakage is less than the maximum allowed.
4. Place the Steam System in operation and waste the condensate for a period of three hours.
 - a. Following approval by the Utility Inspector, return condensate to the Collection System.

33 10 00 – WATER UTILITIES

A. General Information:

1. Most University buildings are served via University–owned, Master Metered Distribution System operated at about 60 to 90 psig unless otherwise noted on Utilities Drawings.
2. Design of building shall include exterior fire hydrants, interior fire protection, main line tap and valve, main building shut–off valve inside and outside, and water meter located in the building near point of water entrance.

B. Water Utility Distribution Piping:

1. Acceptable Products:
 - a. Direct bury application:

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- i. PVC DR14, pressure rating 305, with push-on joints or Ductile Iron Pipe (DIP), pressure class 350, with push-on joints
- b. Directional bore application:
 - i. Certa-Lok PVC
 - ii. HDPE SDR 11

2. Products not Allowed:

- a. Fusible PVC

3. Discussion:

- a. PVC piping shall be manufactured in accordance with AWWA C900.
- b. All PVC water piping shall be “blue” color.
- c. DIP shall be manufactured in accordance with AWWA C151/ANSI A21.51.
- d. DIP shall have a bituminous coating, minimum thickness of 1 mil, on the pipe exterior.
- e. DIP shall have standard thickness cement mortar linings in accordance with AWWA Standard C104/A21.4.
- f. DIP shall have corrosion protection. The need for protection shall be evaluated during design.
- g. HDPE piping and fittings shall be manufactured in accordance with AWWA C906.
- h. Nominal laying lengths of direct bury pipe shall be minimum 18’-0”.
- i. Except when making closure connections to fittings, random/cut lengths of pipe are not allowed.
- j. Fittings and couplings for PVC and DIP shall be manufactured in accordance with AWWA C104, C110, and C111.
- k. All fittings of direct bury pipe shall be mechanical joint.
- l. Fittings and couplings shall be made of ductile iron, and have a minimum working pressure rating of 250 psi.
- m. Couplings between a branch on a cross or tee and a valve shall be a manufactured type coupling.
- n. Mechanical joint restraint devices shall be either full concentric circle or wedge load types.
- o. The push-on joint both upstream and downstream of a change in direction shall be restrained.
- p. Coordinate bedding material with FM Utility Services during design.

C. Water Utility Distribution Valves:

1. Acceptable Products:

- a. Muller 2360 series with powder epoxy coating both inside and out
- b. American Flow Control
- c. Clow Valve Company
- d. Or approved equal

2. Products not Allowed:

- a. None listed

3. Discussion:

- a. All distribution valves shall be resilient-seat gate valves manufactured in accordance with AWWA Standard C509.
- b. Valves shall be equipped with 2” square operating nuts and buffalo valve boxes 5-1/4” in diameter, complete with bonnet.
- c. The word "Water" shall be cast in the valve box cover.
- d. Valves shall be Right-Hand Open.
- e. Valves in roadways and sidewalks shall have valve box lids set flush with the paving.

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D. Water Utility Distribution Fire Hydrants:

1. Acceptable Products:
 - a. Mueller Super Centurion No. A-423
 - b. AVK Series 27 Modern Style
 - c. Watrous Pacer 100
 - d. Or approved equal
2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Fire hydrants shall be manufactured in accordance with AWWA Standard C502.
 - b. Fire hydrants shall be installed in accordance with AWWA Manual M17.
 - c. Hydrants shall be three-way.
 - d. Outlets shall be National Standard as follows:
 - i. Two 2-1/2" hose couplings with 7-1/2 threads per inch.
 - ii. One 4-1/2" steamer hose coupling with 4 threads per inch.
 - e. Main valve opening size 5-1/4", compression type.
 - f. Operating nut shall be 1" square.
 - g. Hydrants shall be Right-Hand Open.
 - h. Hydrant connection shall be either 6" flanged or mechanical joint.
 - i. Hydrant service leg shall include a 6" isolation valve at the main.
 - j. Standard bury length shall be 5'-0".
 - k. The exposed portion of the hydrant shall be painted with Devco Safety Yellow No. 58158-01.

E. Water Utility Metering:

1. Acceptable Products:
 - a. Sensus OMNI C2
 - b. Or approved equal
2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. Meter shall include integral strainer and digital pulse signal output.
 - b. Meter shall be provided and installed as a part of the Project.
 - c. Coordinate meter sizing and start-up with FM Utility Services through the Project Representative.
 - d. Provide a straight run of piping, the length of which shall conform to Manufacturer's recommendations, upstream and downstream of the meter.
 - e. The meter shall be oriented per Manufacturer's recommendations.
 - f. Register shall be installed at the same time as the meter. If a compound meter, make sure that the high-and low-flow registers are correctly installed.
 - g. FM Utility Services staff shall install the necessary AMI module after the Contractor installation is complete and passes inspection.
 - h. Bypass around the water utility meter is prohibited.

33 30 00 – SANITARY SEWERAGE

A. Sanitary Sewer Utility Piping:

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1. Acceptable Products:
 - a. PVC DR35 with push-on joints
 2. Products not Allowed:
 - a. None listed
 3. Discussion:
 - a. All sewer main and service line materials shall conform to applicable ASTM standards and Manufacturer recommendations for installation.
 - b. All PVC sewer piping shall be “green” color.
 - c. Plastic gravity wastewater pipe and all fittings shall be manufactured in accordance with ASTM D3034.
 - d. Joints shall be of the push-on bell and spigot type, and shall be manufactured in accordance with ASTM D3212.
 - e. Gaskets shall be of O-ring type and manufactured in accordance with ASTM F477.
 - f. Bells shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket, which is positively retained.
 - g. Coordinate bedding material with FM Utility Services during design.
 - h. All water line crossings shall conform to Colorado Department of Public Health & Environment (CDPHE) “Design Criteria for Potable Water Systems” (e.g. encasement, separation).
- B. Sanitary Sewer Service Connections:
1. All service connections shall be made at a manhole. If a manhole does not exist at a connection point, one shall be installed.
 2. A two-way cleanout shall be installed at the building entry.
- C. Sanitary Sewer Utility Pumping Stations:
1. Not preferred. Coordinate with FM Utility Services if pumping stations are unavoidable.
- D. Sanitary Sewer Utility Force Mains:
1. Not preferred. Coordinate with FM Utility Services if pumping stations are unavoidable.
- E. Septic Tanks:
1. Where site conditions are favorable, the University encourages the design and construction of non-standard Systems, such as evapo-transpiration beds and Constructed Wetland Systems, provided Larimer County Department of Health and Environment reviews and approves the design prior to construction.
 - a. If the System is a constructed wetland, an individual domestic wastewater discharge permit must be obtained before construction can commence.
- F. Sanitary Sewer Utility Manholes, Covers, and Cleanouts:
1. Manholes shall not be located in areas subject to flooding or ponding from surface runoff.
 2. If the possibility of surface runoff cannot be avoided or if a manhole is located in the 100-year floodplain, the manhole shall have a watertight, bolted cover with an integral O-ring gasket.

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3. Manhole bases, benches and inverts shall be true to line and grade and smoothed with a light broom finish.
4. All manhole sections shall have two gaskets per section joint (one inside and one outside).
5. Preformed plastic gaskets shall conform to AASHTO M198 and Federal Specification SS–S–00210(210A).
6. Gaskets must be pliable at the time of installation.
7. Primer is required on all joints. Primer shall be supplied by the Gasket Manufacturer.
8. Provide manholes at all sewer line junctions and changes in direction. In some cases, cleanouts shall be allowed for lines 4” and smaller, but only upon specific approval of FM Utility Services.
9. All drop manholes shall conform to standard detail in the CSU Facilities Planning, Design and Construction Standards – Additional Documents.
10. Manhole lids shall have Aurora or Denver pick hole (concealed edge pry) to fit a lifter for removal.
11. Manhole lids for sanitary service shall have “SEWER” stamped into the lid.
12. Manholes in roadways and sidewalks shall have smooth lids set flush with the paving.
13. Cleanouts in vehicle traffic areas must be a traffic rated two–way type as referenced in Drawings Appendix.

33 40 00 – STORMWATER UTILITIES

- A. During the Conceptual Design and Design Development phases of a Project, the Designer must contact the CSU Floodplain Manager and evaluate the potential impact of the Project to the CSU Floodplain.
- B. If the Project boundary intersects with any portion of the CSU floodplain, the Project is required to retain CSU’s Floodplain Consultant to model the floodplain in the immediate vicinity of the Project, taking into account the Project structures and associated grading, and develop appropriate mitigation.
 1. Upon completion of Work in the CSU floodplain, a final certification survey and letter is required to be prepared and submitted to the Project Representative documenting the final grades and elevations of all exterior portions of the Project and all building openings.
- C. Storm sewer inlets shall be protected from excessive sediment and debris during construction Projects through erosion control efforts such as filter fabric, bales of hay, river rock, barricades, holding ponds, etc.
- D. Erosion Control Plans shall be required and submitted to the Project Representative for all Projects that have the potential for erosion.
 1. For additional information on Temporary Facilities and Controls, refer to Division 01 – General Requirements.
- E. Stormwater Utility Piping:
 1. Acceptable Products:

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- a. PVC DR35 with push-on joints
 - b. Reinforced Concrete Pipe (RCP) with push-on joints
2. Products not Allowed:
- a. None listed
3. Discussion:
- a. Stormwater main and service lines smaller than 18” nominal size shall be PVC. Lines 18” and larger nominal size shall be RCP.
 - b. All stormwater main and service line materials shall conform to applicable ASTM standards and Manufacturer recommendations for installation.
 - c. All PVC stormwater piping shall be “green” color.
 - d. Plastic gravity stormwater pipe and all fittings shall be manufactured in accordance with ASTM D3034.
 - e. Joints for PVC pipe shall be of the push-on bell and spigot type, and shall be manufactured in accordance with ASTM D3212.
 - f. Gaskets shall be of O-ring type and manufactured in accordance with ASTM F477.
 - g. Bells on PVC pipe shall be formed integrally with the pipe and shall contain a factory installed elastomeric gasket, which is positively retained.
 - h. RCP shall be manufactured in accordance with ASTM C76.
 - i. RCP joints shall incorporate an o-ring or profile type gasket manufactured in accordance with ASTM C443.
 - i. Gaskets shall be pre-lubricated, or lubricated per Manufacturer’s instructions.
 - j. Coordinate bedding material with FM Utility Services during design.
 - k. All water line crossings shall conform to CDPHE “Design Criteria for Potable Water Systems” (e.g. encasement, separation).
- F. Service Connections:
1. All service connections shall be made at a manhole.
 2. If a manhole does not exist at a connection point, one shall be installed.
 3. A two-way cleanout shall be installed at the building entry.
- G. Stormwater Utility Catchbasins:
1. Acceptable Products:
 - a. None listed
 2. Products not Allowed:
 - a. None listed
 3. Discussion:
 - a. Stormwater catch basins and inlets shall be permanently labeled “No Dumping. Drains to River” using either an embossed lid or stamped wording in the surrounding concrete.
 - i. CSU’s concrete stamp shall be used for this purpose.
- H. Stormwater Utility Pumping Stations:
1. Not preferred. Coordinate with FM Utility Services if pumping stations are unavoidable.
- I. Stormwater Detention and Water Quality Infrastructure:

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1. Prohibited Elements:

- a. Due to premature failure likelihood, CSU prohibits the inclusion of permeable concrete.
- b. Due to maintenance burden, corrosion likelihood and the reduction of pervious surface, CSU prohibits underground stormwater detention facilities.

J. Stormwater Utility Manholes, Covers, and Cleanouts:

1. Manhole bases, benches and inverts shall be true to line and grade and smoothed with a light broom finish.
2. All manhole sections shall have two gaskets per section joint (one inside and one outside).
3. Preformed plastic gaskets shall conform to AASHTO M198 and Federal Specification SS–S–00210(210A).
4. Gaskets must be pliable at the time of installation.
5. Primer is required on all joints. Primer shall be supplied by the Gasket Manufacturer.
6. Provide manholes at all stormwater line junctions and changes in direction. In some cases, cleanouts shall be allowed for lines 4” and smaller, but only upon specific approval of FM Utility Services.
7. All drop manholes shall conform to standard detail in the CSU Facilities Planning, Design and Construction Standards – Additional Documents.
8. Manhole lids shall have Aurora or Denver pick hole (concealed edge pry) to fit a lifter for removal.
9. Manhole lids for stormwater service shall have “STORM” stamped into the lid.
10. Manholes in roadways and sidewalks shall have smooth lids set flush with the paving.
11. Cleanouts in vehicle traffic areas must be a traffic rated two-way type as referenced in Drawings Appendix.

K. Subdrainage:

1. Permanent groundwater dewatering should be avoided.
2. Systems that require groundwater treatment on a permanent basis are prohibited.
 - a. Alternative construction shall be implemented to avoid permanent groundwater pumping that requires treatment.
 - b. To determine whether treatment shall be required, evaluate the groundwater within the Project Footprint through sampling and analysis, and review the most current State regulations and policies.
3. Groundwater dewatering during construction shall be managed in accordance with Part IV – Regulatory Requirements.

33 50 00 – HYDROCARBON UTILITIES

A. General Information:

1. Operational and building design information for the Main Campus natural gas utility:

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- a. System pressure east of the Center Avenue mall:
 - i. 5 psig
 - b. System pressure west of the Center Avenue mall:
 - i. 20 psig
 - c. Coordinate with FM Utility Services on available capacity.
2. Natural gas utilities on South, Foothills, and ARDEC campuses may or may not be owned by the University.
 - a. Coordinate with FM Utility Services.
 3. All new building gas services shall include a meter and a regulator to be provided and installed by the Contractor.
- B. Natural Gas Utility Piping:
1. Acceptable Products:
 - a. Polyethylene (MDPE) with butt fused joints
 2. Products not Allowed:
 - a. Metal piping of any kind
 - b. Compression fittings of any kind
 3. Discussion:
 - a. All MDPE natural gas piping shall be “yellow” in color.
 - b. MDPE piping shall be manufactured in accordance with ASTM D2513 and IAPMO standards where applicable.
 - c. Coordinate bedding material with FM Utility Services during design.
- C. Natural Gas Risers:
1. Risers shall be anodeless with an MDPE fusion connection.
 2. Compression fittings are prohibited.
- D. Natural Gas Regulators:
1. Acceptable Products:
 - a. Sensus series 243 or series 143–80
 2. Products not Allowed:
 - a. No substitutions are allowed
 3. Discussion:
 - a. Integral low–pressure cutoffs are prohibited.
 - b. Coordinate with FM Utility Services on regulator choice.
- E. Natural Gas Utility Metering:
1. Acceptable Products:
 - a. For smaller loads:
 - i. Sensus Sonix model 600, 800, or 2000
 - b. For larger loads:
 - i. Dresser Roots Rotary Series B3 with temperature–compensated, single solid–state pulser output index

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- ii. Eagle Research Corporation pressure compensation kit MP Plus II appropriate to selected Series B3 meter
2. Products not Allowed:
 - a. No substitutions are allowed
3. Discussion:
 - a. Coordinate with FM Utility Services to coordinate meter choice with load sizing.
 - b. Meter shall be provided and installed as a part of the Project.
 - c. Coordinate meter sizing and start-up with FM Utility Services.
 - d. The meter shall be installed per Manufacturer's recommendations and with correct meter orientation.
 - e. FM Utility Services staff shall install the necessary AMI module after the Contractor installation is complete and passes inspection.

33 61 00 – HYDRONIC ENERGY DISTRIBUTION

A. Chilled Water Utility – General Information:

1. Central chilled water utilities exist on Main, South, and Foothills Campuses.
 - a. Per applicable CSU Master Plans, specified areas shall be served by these utilities.
 - b. Coordinate with FM Utility Services for new construction and renovation projects during the planning phase.
2. Operational and building design information for the Main Campus chilled water utility. Buildings connecting to this utility shall be designed to meet these parameters:
 - a. Supply Temperature delivered from the utility:
 - i. 43 °F at building
 - b. Return Temperature received by the utility:
 - i. 58 °F at building peak load
 - c. Delta Temperature at utility entry:
 - i. 15 °F at building peak load
 - d. System Static Pressure:
 - i. 40–50 psig
 - e. System Dynamic Pressure:
 - i. Maximum 15 psig differential across building; depending on building location within the Distribution System, booster pumping shall be necessary.
 - f. System Flow:
 - i. Variable flow
 - g. System Fluid:
 - i. Water with corrosion inhibitor – no glycol
3. Operational and building design information for the South Campus chilled water utility. Buildings connecting to this utility shall be designed to meet these parameters:
 - a. Supply Temperature delivered from the utility:
 - i. 43 °F at building
 - b. Return Temperature received by the utility:
 - i. 58 °F at building peak load
 - c. Delta Temperature:
 - i. 15 °F at building peak load
 - d. System Static Pressure:
 - i. 40–50 psig
 - e. System Dynamic Pressure:

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- i. Maximum 15 psig differential across building; depending on building location within the Distribution System, booster pumping shall be necessary.
 - f. System Flow:
 - i. Variable flow
 - g. System Fluid:
 - i. 30% propylene glycol
- 4. Operational and building design information for the Foothills Campus chilled water utility. Buildings connecting to this utility shall be designed to meet these parameters:
 - a. Supply Temperature delivered from the utility:
 - i. 43 °F at building
 - b. Return Temperature received by the utility:
 - i. 58 °F at building peak load
 - c. Delta Temperature:
 - i. 15 °F at building peak load
 - d. System Static Pressure:
 - i. 30 psig
 - e. System Dynamic Pressure:
 - i. Maximum 15 psig differential across building; depending on building location within the Distribution System, booster pumping shall be necessary.
 - f. System Flow:
 - i. Variable flow
 - g. System Fluid:
 - i. Water with corrosion inhibitor – no glycol
- 5. All buildings shall be separated from the utility by a flat plate heat exchanger with associated pumping and accessories on the building side loop.
- 6. Control valves on all direct connected equipment (heat exchangers) shall be Flow Control Industries DP Valve.
 - a. No substitutions are allowed.

B. Chilled Water Utility Piping:

- 1. Acceptable Products:
 - a. Piping
 - i. High Density Polyethylene (HDPE)
 - ii. SDR 11.0 conforming to ASTM D3350, F714
 - iii. API 5LE
 - b. HDPE Flange Adapters
 - i. Marzoff class 150 backing ring E-coat epoxy
 - ii. Marzoff class 150 backing ring 316 stainless steel
 - iii. Or approved equal
- 2. Products not Allowed:
 - a. No other piping materials allowed.
- 3. Discussion:
 - a. Identify the nominal pipe size on all Drawings, schedules and in Specifications.
 - i. Do not use the I.D. or O.D. of the pipes.
 - b. Piping and fittings shall be butt-fused, unless an exception is approved by FM Utility Services.
 - c. All fittings shall be HDPE, SDR 11.0, to match the adjoining pipe.
 - d. Transition to valves shall be by HDPE butt-fused flange adapter.

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- i. Flange adapters shall be secured with stainless steel nuts and bolts and an anti-seize lubricant.
- e. For situations where butt fusion is not possible, an HDPE butt-fused flange adapter shall be used.
- f. Electric fusion couplings are prohibited.
 - i. Requests for variance shall be made to FM Utility Services and shall be approved only when other connection methods are not possible.
- g. Distribution and branch piping configuration:
 - i. For all supply and return pairs, the supply piping shall be either the east or south pipe, or the lower pipe if vertically stacked.
 - ii. For all supply and return pairs, the return piping shall be either the west or north pipe, or the upper pipe if vertically stacked.
- h. Coordinate bedding material with FM Utility Services during design.

C. Chilled Water Utility Service Connections:

1. Site conditions shall dictate the configuration of the taps and associated branch lines.
 - a. Coordinate with FM Utility Services on all taps.
2. In general, service connections must be hot tapped.
 - a. Coordinate with FM Utility Services on the possibility of shut-downs of mains.
3. Supply and return service taps onto distribution mains shall be done with either epoxy coated mechanical saddle or electrofusion saddle.
4. Bottom taps are prohibited.

D. Chilled Water Utility Valves:

1. Acceptable Products:
 - a. Butterfly Valves:
 - i. K-Flo Model 504
 - ii. DeZurik BAW
 - iii. Or approved equal
 - b. Gate Valves:
 - i. Muller 2360 series with powder epoxy coating both inside and out,
 - ii. American Flow Control
 - iii. Clow Valve Company
 - iv. Or approved equal
2. Products not Allowed:
 - a. None listed
3. Discussion:
 - a. All valve connections shall be flanged.
 - b. All valves shall be Right-Hand Close.
 - c. Butterfly valves shall meet or exceed AWWA C504 standard.
 - d. Gate valves shall meet or exceed AWWA C509 standard and be rated for 150 PSIG.
 - e. For butterfly valve installation, pressure rated HDPE beveled flanges or beveled spacers shall be used.
 - i. Modifying un-beveled HDPE flanges is prohibited.
 - f. All buried valves shall be field tested to ensure that the valve has full operation from open to closed, without any binding or blockage, both before and after the valve is buried.

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E. Chilled Water Utility Metering:

1. Acceptable Products:
 - a. Dynasonics TFX 5000 ultrasonic energy meter
2. Products not Allowed:
 - a. No other products are allowed.
3. Discussion:
 - a. This section pertains to chilled water utility energy metering.
 - b. This does not pertain to BAS flow metering.
 - i. The utility energy meter is not connected to the building BAS.
 - c. Site selection and installation are critical for accurate measurement.
 - i. Install per Manufacturer documentation.
 - d. Provide straight pipe run, with no fittings, valves, taps, or accessories, of at least 15 pipe diameters in length, 10 upstream, 5 downstream, for the chilled water metering location.
 - e. Chilled water meters are read remotely over the CSU utility network using Modbus over TCP/IP protocol.
 - f. Provide a CAT-6 drop from the building IDF to the chilled water meter location for communication.
 - g. Meter installation shall include factory start-up.
 - h. Coordinate metering locations with FM Utility Services.
4. Specification:
 - a. Meter:
 - i. Part number:
 - a) DR-G-[Transducer Type]-R-S-[Transducer Cable Length]-WW-C-[RTD Cable Length]-S-XX-T-G-R-S
 - b) Clamp-on, ultrasonic energy meter, US region, remote mounted, integral display, no included conduit, commercial surface RTDs, ½" NPT threads on head, included poly cable glands, standard output plus Modbus TCP/IP communication, calibration in gallons per minute.
 - b. Transducer Type:
 - i. Choose correct transducer type from manufacturer documentation for pipe size.
 - ii. Include optional transducer rail.
 - c. Transducer Cable Length:
 - i. Select cable length in the model number for appropriate distance from transducer location to meter location.
 - ii. These cables come in specific sizes and cannot be cut or spliced.
 - d. RTD Cable Length:
 - i. Select cable length in the model number for appropriate distance from RTD locations to meter location.
 - ii. These cables come in specific sizes and cannot be cut or spliced.

F. Heating Water Utility – General Information:

1. In support of the District Energy Master Plan, which is a key element of energy and sustainability goals for the University, the heating utility serving Main Campus will be converted from steam to hot water.
2. The following section addresses the new utility and is coordinated with other Divisions of the CSU Facilities Planning, Design and Construction Standards.

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3. For building-side design and construction considerations affected by the conversion, refer to Division 22 – Plumbing and Division 23 – HVAC.
4. A central heating water utility exists on Main Campus.
 - a. Per applicable CSU Master Plans, specified areas shall be served by this utility.
 - b. Coordinate with FM Utility Services for new construction and renovation projects during the planning phase.
5. Operational and building design information for the Main Campus heating water utility. Buildings connecting to this utility shall be designed to meet these parameters:
 - a. Supply Temperature delivered from the utility:
 - i. 145 °F at building
 - b. Return Temperature received by the utility:
 - i. 115 °F at building peak load
 - c. Delta Temperature at utility entry:
 - i. 30 °F at building peak load
 - d. System Static Pressure:
 - i. 40–50 psig
 - e. System Dynamic Pressure:
 - i. Maximum 15 psig differential across building; depending on building location within the Distribution System, booster pumping shall be necessary.
 - f. System Flow:
 - i. Variable flow
 - g. System Fluid:
 - i. Water with corrosion inhibitor – no glycol
6. All buildings shall be separated from the utility by a flat plate heat exchanger with associated pumping and accessories on the building side loop.
7. Control valves on all direct connected equipment (heat exchangers) shall be Flow Control Industries DP Valve.
 - a. No substitutions are allowed.

G. Heating Water Utility Piping:

1. Acceptable Products:
 - a. Piping
 - i. TBD – Coordinate with FM Utility Services during design.
2. Products not Allowed:
 - a. TBD
3. Discussion:
 - a. Identify the nominal pipe size on all Drawings, schedules and in Specifications.
 - i. Do not use the I.D. or O.D. of the pipes.
 - b. Distribution and branch piping configuration:
 - i. For all supply and return pairs, the supply piping shall be either the east or south pipe, or the lower pipe if stacked.
 - ii. The return piping shall be either the west or north pipe, or the upper pipe if stacked.
 - c. Coordinate bedding material with FM Utility Services during design.

H. Heating Water Utility Service Connections:

1. Site conditions shall dictate the configuration of the taps and associated branch lines.

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- a. Coordinate with FM Utility Services on all taps.
 2. In general, service connections must be hot tapped.
 - a. Coordinate with FM Utility Services on the possibility of shut-downs of mains.
 3. Bottom taps are prohibited.
- I. Heating Water Utility Valves:
1. Acceptable Products:
 - a. Butterfly Valves:
 - i. K-Flo Model 504
 - ii. DeZurik BAW
 - iii. Or approved equal
 - b. Gate Valves:
 - i. Muller 2360 series with powder epoxy coating both inside and out,
 - ii. American Flow Control
 - iii. Clow Valve Company
 - iv. Or approved equal
 2. Products not Allowed:
 - a. None listed
 3. Discussion:
 - a. All valve connections shall be flanged.
 - b. All valves shall be Right-Hand Close.
 - c. Butterfly valves shall meet or exceed AWWA C504 standard.
 - d. Gate valves shall meet or exceed AWWA C509 standard and be rated for 150 PSIG.
 - e. All buried valves shall be field tested to ensure that the valve has full operation from open to closed, without any binding or blockage, both before and after the valve is buried.
- J. Heating Water Utility Metering:
1. Acceptable Products:
 - a. Dynasonics TFX 5000 ultrasonic energy meter
 2. Products not Allowed:
 - a. No other products are allowed.
 3. Discussion:
 - a. This section pertains to heating water utility energy metering.
 - b. This does not pertain to BAS flow metering.
 - i. The utility energy meter is not connected to the building BAS.
 - c. Site selection and installation are critical for accurate measurement.
 - i. Install per Manufacturer documentation.
 - d. Provide straight pipe run, with no fittings, valves, taps, or accessories, of at least 15 pipe diameters in length, 10 upstream, 5 downstream, for the heating water metering location.
 - e. Heating water meters are read remotely over the CSU utility network using Modbus over TCP/IP protocol.
 - f. Provide a CAT-6 drop from the building IDF to the heating water meter location for communication.
 - g. Meter installation shall include factory start-up.
 - h. Coordinate metering locations with FM Utility Services.

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4. Specification:
 - a. Meter:
 - i. Part number:
 - a) DR–G–[Transducer Type]–R–S–[Transducer Cable Length]–WW–C–[RTD Cable Length]–S–XX–T–G–R–S
 - b) Clamp–on, ultrasonic energy meter, US region, remote mounted, integral display, no included conduit, commercial surface RTDs, ½” NPT threads on head, included poly cable glands, standard output plus Modbus TCP/IP communication, calibration in gallons per minute.
 - ii. Choose correct transducer type from manufacturer documentation for pipe size.
 - iii. Include optional transducer rail.
 - iv. Ensure that couplant used is rated for service at heating water temperatures.
 - b. Transducer Type:
 - i. Choose correct transducer type from manufacturer documentation for pipe size.
 - ii. Include optional transducer rail.
 - iii. Ensure that couplant used is rated for service at heating water temperatures.
 - c. Transducer Cable Length:
 - i. Select cable length in the model number for appropriate distance from transducer location to meter location.
 - ii. These cables come in specific sizes and cannot be cut or spliced.
 - d. RTD Cable Length:
 - i. Select cable length in the model number for appropriate distance from RTD locations to meter location.
 - ii. These cables come in specific sizes and cannot be cut or spliced.

33 63 00 – STEAM ENERGY DISTRIBUTION

A. General Information:

1. Steam is distributed on Main Campus from the central steam plant in utility tunnels and direct buried lines.
2. Steam condensate is returned to the Main Campus central steam plant through piping in utility tunnels or direct buried lines.
 - a. The steam utility on Main Campus is being retired and replaced by a heating water utility.
 - b. New construction and renovation in areas that are currently served by the steam utility shall be served by the heating water utility.
 - c. Coordinate with FM Utility Services on strategies for conversion.
3. Operational and building design information for the steam utility:
 - a. Steam distribution pressure:
 - i. 45 psig
 - b. Steam distribution pressure variation:
 - i. +/- 5 psig
 - c. Steam and condensate piping, fittings, valves, and specialties shall be rated for 150 psig
 - d. Condensate distribution piping is gravity return to the plant
 - e. Condensate back–pressure in the mains shall be as high as 30 psig during peak load times
4. All steam and condensate lines in tunnels and trenches shall be insulated.
 - a. Valves, strainers, and other equipment shall be insulated with removable preformed insulated casings or jackets.

B. Steam and Condensate Piping:

1. Acceptable Products:
 - a. Perma–Pipe Multi–Therm 750 Supreme
 - b. Rovanco Insul–800 Elite

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- c. Approved equal
 - 2. Products not Allowed:
 - a. No substitutions allowed
 - 3. Discussion:
 - a. Either FRP or HDPE wrap is acceptable.
 - b. Steam carrier piping shall be schedule 40, A53B Style S or A106B.
 - c. Condensate carrier piping shall be schedule 80, A53B Style S or A106B.
 - d. Both Steam and condensate carrier piping shall be butt welded for sizes 2–1/2” and larger and socket welded for 2” and below.
 - e. All utility steam piping thermal expansion shall be designed for 150 psig saturated steam (366°F).
 - f. All utility condensate piping thermal expansion shall be designed for 15 psig saturated steam (250°F).
 - g. Piping runs shall be comprised of one Manufacturer only.
 - i. Switching between Manufacturers is only acceptable in vaults and tunnels.
 - h. All straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions.
 - i. End seals, gland seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the System.
 - i. All subassemblies shall be designed to allow for complete draining and drying of the Conduit System.
 - j. Each System layout shall be computer analyzed by the Piping System Manufacturer to determine stresses and movements of the service pipe.
 - k. The System design shall be in strict conformance with ANSI B31.1, latest edition, and stamped by a Registered Professional Engineer.
 - l. Flanged connections shall utilize spiral wound gaskets and B–7 Stud Bolts w/XH Nuts. Threads shall be anti–seized.
 - m. Coordinate bedding material with FM Utility Services during design.
 - n. Coordinate with FM Utility Services on connections between piping systems from two different manufacturers.
- C. Steam and Condensate Service Connections:
- 1. All service connections shall be made at an existing anchor point.
 - 2. All service connections shall originate from a vault or tunnel. If no vault exists, one shall be installed.
- D. Steam and Condensate Valves:
- 1. Acceptable Products:
 - a. Steam Butterfly Valves:
 - i. Jamesberry
 - ii. Keystone K–LOK Model 362 with lugged carbon body, 316ss disc and seat and gear actuator with hand wheel
 - iii. Vanessa 30,000 or 32,500 series
 - iv. Or approved equal
 - b. Steam Gate Valves:
 - i. Crane
 - ii. Jenkins
 - iii. Lunkenheimer

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- iv. Milwaukee
- v. Stockham
- vi. Walworth
- vii. Or approved equal
- c. Condensate Butterfly Valves:
 - i. Jamesberry,
 - ii. Keystone K–LOK Model 362 with lugged carbon body, 316ss disc and seat and gear actuator with hand wheel
 - iii. Vanessa 30,000 or 32,500 series
 - iv. Or approved equal
- d. Condensate Gate Valves:
 - i. Crane
 - ii. Jenkins
 - iii. Lunkenheimer
 - iv. Milwaukee
 - v. Stockham
 - vi. Walworth
 - vii. Or approved equal

2. Products not Allowed:

- a. None listed

3. Discussion:

- a. Butterfly valves are allowed for branch line isolation up to 6".
 - i. Butterfly valves shall be handwheel operated.
 - ii. Lever operation is not allowed.
- b. Butterfly valves shall include a bypass with globe valve for warming.
- c. Gate valves with rising stems shall be installed unless space does not allow. If space does not allow, then non–rising stems are acceptable.

E. Steam and Condensate Piping Specialties – Traps:

1. Acceptable Products:

- a. Armstrong 2011 inverted bucket with universal block on all distribution drip legs

2. Products not Allowed:

- a. No substitutions allowed

3. Discussion:

- a. Specific methods and locations of trapping shall be specified in design plans.
- b. Pipe materials for trap assemblies shall be schedule 80 A53–B Style S or A106–B.
- c. Trap assemblies shall be socket weld or thread.

F. Steam and Condensate Piping Specialties – Expansion:

1. Acceptable Products:

- a. Advanced Thermal Systems, Inc. Thermal Pak TP2
- b. Hyspan
- c. Or approved equal

2. Products not Allowed:

- a. None listed

3. Discussion:

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- a. None listed

G. Steam Metering:

1. Acceptable Products:
 - a. VORTEK Instruments Pro-V series Model M24R
2. Products not Allowed:
 - a. No other products are allowed
3. Discussion:
 - a. Insertion meters are not allowed.
 - b. Proper sizing, selection, and installation are critical for accurate measurement.
 - i. Coordinate with FM Utility Services on meter selection for optimal sizing to accommodate peak and low steam flows.
 - ii. Steam piping sections may need to be reduced in diameter to achieve optimal metering flow rates.
 - iii. Coordinate with FM Utility Services to optimize balance between steam pipe sizing in the meter run and selected meter size.
 - c. Site selection and installation are critical for accurate measurement.
 - i. Install per Manufacturer documentation and coordinate with FM Utility Services to ensure correct site selection.
 - d. Provide straight pipe run of at least 15 pipe diameters in length, 10 upstream, 5 downstream, for the steam metering location.
 - i. Run must be located downstream of building isolation valve and upstream of any branching lines, taps or PRV's.
 - e. Steam meters are read remotely over the CSU utility network using Modbus over TCP/IP protocol.
 - f. Provide a CAT-6 drop from the building IDF to the steam meter location for communication.
 - g. Meter installation shall include factory start-up.
4. Specification:
 - a. Meter:
 - i. Part Number:
 - a) M24R-VTP-[Line Size]-S-300-[Electronics Enclosure]-DD-DCHPOE-1AMIP-ST-P2
 - ii. Inline reducing meter body, velocity, temperature, and pressure sensors, stainless steel, 300-pound ANSI flange, digital display, power over ethernet, Modbus TCP/IP communication, standard temperature, maximum 100 psia.
 - b. Line Size:
 - i. The meter body flange size and reduction size need to be chosen to render most dependable readings at both peak and low flows.
 - ii. Coordinate with FM Utility Services on optimal sizing.
 - c. Electronics Enclosure:
 - i. Meter electronics (processor) can be mounted remotely.
 - ii. Standard is a remote head with a 50'-0" cable.

33 70 00 – ELECTRICAL UTILITIES

A. Underground Electrical Service:

1. FM Utility Services shall design most power distribution building services to include the primary electrical, transformer, and utility metering.
 - a. Underground electrical primary shall meet the requirements outlined in this section.

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2. Service (primary) – Primary distribution is owned by the University.
 - a. The Systems in use at the University are 13.2 KV ungrounded Wye.
 - b. Assume all Systems are ungrounded in Cable Specifications.
 - c. Coordinate with FM Utility Services for further information.
 - d. Transformers connected to these Systems shall have Delta primaries.
3. Unless otherwise stated during the Request for Proposal (RFP) and/or pre–design conference, FM Utility Services shall furnish and install primary duct bank, vaults, 15kV sectionalizing switches, 15kV cable, transformer and transformer pad.
 - a. FM Electric Shop shall make cable terminations at utility junction point and building transformer.
4. The cost of the primary duct bank, vault(s), 15kV sectionalizing switch(es), 15kV cable, transformer and transformer pad and installation shall be a part of the Project Budget.
5. All buildings are to be provided with an Elster AMI (wireless mesh) master watt–hour meter, 15 minute demand register.
 - a. By–pass switches to be provided in meter housing for meter removal and test of meter. Do not specify primary rated meter.
 - b. This meter is typically sized and furnished by CSU. If meter is not provided by CSU, coordinate Meter Specifications directly with CSU.
 - i. Contact Project Representative for confirmation of meter scope on a Project–specific basis.

33 71 19 – ELECTRICAL UNDERGROUND DUCTS, DUCT BANKS AND MANHOLES

- A. For some projects, the Contractor shall provide a new underground vault(s) and primary duct bank.
 1. Whenever vault(s) and/or primary duct bank are required, the details shall be discussed at the pre–design conference.
- B. Design Drawings and Specifications for vaults and primary duct bank shall be provided by FM Utility Services.
- C. Duct Bank (primary) – Underground 13.2 KV raceway shall be encased in concrete.
 1. All concrete must be at least 3000–psi compressive strength.
 - a. Encasement concrete envelope shall be natural color, 3000 psi minimum compressive strength and installed with a minimum of 4” cover on all sides of the raceway.
 - b. For example, 4” raceway shall require 12” cross section of concrete.
 2. The minimum acceptable raceway shall be PVC Type 1 or equivalent.
 - a. All elbows shall be rigid metal conduit (RMC) or continuous strand epoxy fiberglass with 48” long radius only.
 - b. All underground RMC conduits shall be tar coated or PVC jacketed.
 3. Provide bare copper #4 AWG ground wire above all conduits in the top section of concrete duct bank.
 - a. Refer to CSU Facilities Planning, Design and Construction Standards – Additional Documents for details.
 - b. Connect to Ground Rod Systems at the vault and transformer.
 4. All conduits entering or exiting any structure below grade shall be full–wall galvanized rigid steel or continuous stranded epoxy fiberglass.

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- a. The steel shall extend a minimum of 5’-0” out from the underground structure to minimize shearing risk.
 - b. A transition to other types of conduit can be made at any point beyond this 5-foot minimum distance.
 - c. All galvanized steel conduits shall be either PVC jacketed or tar coated with an asphalt base compound.
5. Vaults (primary) shall be either poured in place or precast.
- a. Refer to CSU Facilities Planning, Design and Construction Standards – Additional Documents for vault details.
6. Warning tape shall be buried a minimum of 6” above all buried electrical, data and control wiring or encasement.
- a. The tape shall be inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils.
 - b. The tape shall be 3” wide, colored red and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."
7. Any individual entering existing or new vaults shall first notify FM Electric Shop at 970-491-0130.
- a. Call FM Dispatch at 970-491-0077 if no one answers call at Electric Shop.
 - b. Follow safety rules for entry to confined space.
8. New vaults shall have a ground rod installed and connected to the primary Grounding System.
- a. Check ground resistance for the installed ground rod.
 - b. If the resistance exceeds the NEC requirements, install up to four ground rods, one in each corner to meet NEC requirements.
 - c. All connections and splicing on primary grounding shall be by exothermic weld (e.g. Cadweld).
9. All conduits shall be cleaned and a correct size mandrel run through each conduit.
- a. A pulling string shall be installed in all conduits.

33 71 49 – MEDIUM VOLTAGE TRANSMISSION WIRING

A. Acceptable Products:

1. Okonite
2. General Cable
3. Houston Wire & Cable
4. Prysmian

B. Medium Voltage Wiring:

1. Main Campus Central:
 - a. 15 KV class cable shall be single aluminum or copper conductor, 220 mil/133% insulated for ungrounded type service, shielded, 105 C rated, EPR insulated with PVC outer jacket.
2. Main Campus, South and Foothills Campus:
 - a. 15 kV class cable shall be single aluminum or copper conductor, 220 mil/133% insulated for ungrounded type service, 1/3 concentric neutral, 105 C rated EPR insulated with PVC outer jacket.

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3. Color-coding shall be:
 - a. A Phase (black)
 - b. B Phase (red)
 - c. C Phase (blue)
4. Terminations:
 - a. 15 kV class unless otherwise requested by FM.
 - b. Provide drain wires on terminations with #10 AWG used on 200 ampere and #6 AWG used on 600-ampere terminations.
5. On Main Campus Central only, specify No. 2 AWG with type THWN 600-volt insulation copper wire in raceway with primary service to building.
 - a. Tie said ground wire to common System ground of building transformer.

C. Installation and Testing:

1. FM Utility Services shall furnish and install 15 kV cables.
2. All 15 kV cables shall be high pot tested.

33 71 73 – ELECTRICAL UTILITY SERVICES

A. Acceptable Products:

1. Elster AMI meters

B. Products not Allowed:

1. No substitutions allowed

C. Electric Metering:

1. The cost of the meter, meter socket, CT cabinet, CTs, and installation shall be a part of the Project Budget.
2. The metering components listed above shall be ordered and installed by FM Utility Services.
3. Coordinate termination of secondary cables with FM Electric Shop.
4. Meters shall utilize the Elster wireless mesh network for two-way communication and remote reading.

33 73 00 – UTILITY TRANSFORMERS

A. Acceptable Products:

1. Primary Transformers (liquid cooled):
 - a. ABB
 - b. GE
 - c. Cooper
 - d. CG Power and Industrial Solutions

B. Products Not Allowed:

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1. Primary Transformers:
 - a. Square D Company

C. Primary Transformers:

1. Transformers used to step down from the University primary voltage to the building secondary voltage shall be non-PCB FR3 liquid-cooled and insulated and installed in accordance with Article 450 of the NEC.
2. Transformers shall be designed and manufactured in accordance with the requirements of ANSI/IEEE C57.12.00 and certified and labeled by Factory Mutual Research Corporation as meeting the requirements of Approval Standard 3990, insulated with an approved less-flammable fluid all in compliance with the current NEC 450-23.
 - a. Special attention shall be given to NEC 450-23, which requires protection of combustible building parts, and building openings from fires originating in less-flammable liquid-insulated transformers.
3. Electrical transformers shall be included as part of the site design and shall be located on the exterior of the building rather than inside the building.
 - a. The transformer shall be located a minimum of 10'-0" from a building.
 - b. If this is not possible, special requirements per Factory Mutual must be followed to protect the building.
4. Transformer windings can be copper or aluminum.
 - a. At a minimum the transformer shall have an efficiency based on Code of Federal Regulations 10CFR Part 431-DOE.
5. Primary bushings for the pad mount transformers shall be dead front, load break, loop feed type.
 - a. The transformer shall have a switching configuration consisting of three 15 kV on-off switches. One for the transformer, one for feeder A, and one for Feeder B.
 - b. Refer to Appendix for One-line diagram of transformer configuration.
6. Where transformers are set in a radial feed configuration, provide lightning arresters on the second set of bushings.
 - a. Arresters shall be 10 KV MOV (Metal Oxide Varistor) rated, phase to ground.
7. Refer to CSU Facilities Planning, Design and Construction Standards – Additional Documents for transformer layout details and transformer pad sizes.
8. Transformer paint color shall be dependent on-site context.
 - a. Final color to be determined by Architectural Design Review Committee.
9. Where building transformer is to be furnished under the building contract, the size is to be determined and approved by FM Utility Services.

D. Transformer shall be furnished and installed by FM Utility Services.

33 77 00 – MEDIUM VOLTAGE UTILITY SWITCHGEAR AND PROTECTION DEVICES

A. Acceptable Products:

1. Switchgear:
 - a. Trayer

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2. Refer to FM Utility Services for Switchgear Specifications.
3. The 15kV sectionalizing switch shall be furnished and installed by FM Utility Services.

33 80 00 – COMMUNICATIONS UTILITIES

A. Communication Transmission:

1. The University owns and maintains its Telephone and Communications Distribution System.
 - a. The CSU Office of Telecommunications is responsible for managing the telecommunications network, including publication of design and construction standards; determination of suitability of proposed uses; compliance with its standards and appropriate codes; periodic removal and replacement of network components; and additions to the network.
2. The Architect/Engineer shall adhere to the Telecommunications Standards published by the Office of Telecommunications for all communication utility and distribution design.
 - a. The Contractor shall comply with the Telecommunications Standards published by the Office of Telecommunications for all communication utility and distribution construction.
 - b. Telecommunications Standards can be found at the following address:
https://it.colostate.edu/wp-content/uploads/sites/6/2023/01/Networking-and-Telecommunications-Design-Standards_01-04-23.pdf
 - c. For Communication Systems distribution standards, refer to Division 27 – Communications.
3. Coordinate with the Office of Telecommunications and Academic Computing and Network Services (ACNS) for number and size of conduits and installation from building to the telecommunications and data network.
 - a. Confirm size, location and origin of conduit and conductors with the Project Representative.
 - b. Refer to Division 27 – Communications.
4. Coordinate with FM Building Automated Services (BAS) for BAS, Fire Alarm and Security Data transmission requirements.
 - a. Confirm size, location and origin of conduit and conductors with the Project Representative.
 - b. Refer to Division 23 – HVAC and Division 28 – Electronic Safety and Security.

END OF DIVISION