UCLA

UNIVERSITY OF CALIFORNIA, LOS ANGELES
CAPITAL PROGRAMS - Design and Construction

MECHANICAL-ELECTRICAL-PLUMBING DESIGN AND CONSTRUCTION STANDARDS

JULY 2023

21 00 00
FIRE SUPPRESSION STANDARDS
JULY 2023

21 00 00 FIRE SUPRESSION

210000 GENERAL REQUIREMENTS

A. DOCUMENT PREPARATIONS

1. Legends, schedules, and notes should contain only items and information that are in the scope of work of that project.
2. The construction documents shall include riser-diagrams for fire protection piping system.
3. All piping shall be sized and shown on the plan of the floor level in which it will be installed.
4. Show on the plans, composite building sections, as needed to verify that all components will fit as shown on the plans. Indicate ducts, pipes, conduit, fan coils units, recessed light fixtures, structural beams soffits etc. at each critical location where such elements cross.
5. Location of all risers, standpipes, floor control valves, shutoff valves and FDC must be shown on the floor plans in addition to the riser diagrams.
6. “As-builts” are required for project close-out
7. Specifications shall be prepared to include only systems, items and materials that are in the scope of work for this project. Review and coordinate each specification section so there will be no contradicting information of specified items or materials.

B. DRAWINGS AND CALCULATIONS

1. Show all calculations on drawings: hydraulic calculations and pipe sizes.
2. 1/4 inch scale or larger equipment room showing each major piece of equipment.
3. Show pipe riser diagrams complete with pipes sizes and appropriate unit values.
4. All equipment schedules must be shown on the plans, not on the specifications. The plans become the campus’ permanent record, and are referred to for maintenance and operations purposes. The specification book is not a readily accessible record.
5. Specification title and numbering shall be based on Master Format (version as approved by University’s Representative) and content shall be in CSI 3-part format (Part 1-General, Part 2-Product, and Part 3-Execution).
6. Fire suppression specification sections shall have separate sections, independent of mechanical and plumbing specification sections.
7. Fire suppression details to be included in the plans (when applicable):
   a. Equipment and piping supports including seismic bracing installed inside and outside the building. Include wind load for exterior installation.
   b. Vibration isolation and seismic restraints
   c. Pump piping detail
   d. Concealed or exposed pipe penetrations through walls, floors and roof. Coordinate with the architect’s drawing.
   e. Underground storage tank
   f. Equipment housekeeping pad
   g. Double check backflow assembly with fire department connections
   h. Floor control valve

8. Nomenclatures

CSP	Combination Standpipe Riser
CSFM	California State Fire Marshal
D	Drain
DI	Ductile Iron
DCA	Double Check Valve Assembly
FA	Fire Alarm
FACP	Fire Alarm Control Panel
FCV	Floor Control Valve
FDC	Fire Department Connection
FH	Fire Hydrant
FP	Fire Pump
GPM	Gallon per Minute
PIV	Post Indicator Valve
PSI	Pound per Square Inch
SOV	Shutoff Valve
SP	Standpipe
SPKR	Sprinkler
ST	Storage Tank

211000 WATER-BASED FIRE SUPPRESSION SYSTEMS

A. Systems are deferred approval and Contractor designed. No layout piping be indicated on the construction drawings. Only the location of sprinkler risers, hub drains or point of drain discharge, and supply mains shall be shown. A reflected ceiling plan is OK if there is an issue of the sprinkler head location.
B. All new construction shall be installed with automatic sprinkler conforming to the requirments of current edition of NFPA 13 as amended by state of California.
C. The fire protection systems shall be specified to be designed per requirements of the applicable state fire code, N.F.P.A. Standards and the University Fire Marshal. The areas to be protected by the sprinkler system including all exterior over-hangs, soffits and covered areas shall be reviewed with and established with the University Fire Marshal and so described in the construction documents.
D. All Contractor submittal drawings and working plans shall be prepared utilizing a computer generated system compatible with UCLA's Auto-CAD drawing system.
E. Fire sprinkler services shall have a double check valve assembly (preferably exterior) at point of entrance into building. If backflow assembly is to be located inside the building, a post indicator valve outside the building shall be required. Metering of the fire service is not required. Location of fire department connection shall be within 100 feet of an existing or new fire hydrant and as approved by the University Fire Marshal. When a fire sprinkler service is to be provided as part of the work, the specifications shall direct the "Contractor to perform flow tests of the site water main in the presence of the University Fire Marshal, that in order to determine the design criteria for the sprinkler system. The Contractor shall provide all equipment necessary for the testing, including control of the discharged water." The note shall also be on the drawings with the fire protection notes.
F. All fire standpipe hose connections shall be located four-feet centerline above finished floor.
G. All fire standpipe hose connections shall be located on the primary stair landing, except at the roof where hose connections shall be located on the roof.

H. All fire standpipe systems shall be designed to comply with requirements of the University Fire Marshal. This shall include location, size and class of system proposed for the project. Standpipe Fire Department Connection(s) shall be located adjacent to the sprinkler FDC. A meeting shall be arranged with the University Fire Marshal's Office to review the standpipe system requirements.
I. In high-rise buildings where a combination standpipe system is required, the University would prefer a Combination System, where the fire sprinkler and standpipe would be from a common service and have a single fire department inlet connection. Fire and jockey pumps along with storage tank may be required. In other than high-rise building where it is determined to have a separate Class I standpipe system, the system shall be manual wet charged thru a ¾" reduced pressure backflow preventer. The system is a Class I Manual Wet Standpipe per NFPA 14, 3-2.5. All hose valves are to be wet type.
J. All interior piping shall be specified Schedule 40 ASTM A53 or A795, TYPE E. Joints shall be threaded with 250 psi rated ductile iron fittings for sizes 2½-inch and smaller. For pipe sizes 3-inch and larger grooved mechanical fittings U/L Listed 250-psi minimum working pressure may be used. All grooved mechanical fittings shall be with stainless steel nut & bolt. Interior riser floor control valves may be approved butterfly type. Pipe shall be continuously marked at the pipe foundry with the schedule and ASTM reference.
K. Applications where magnetic field is used such as MRI room Non-Ferrous piping material shall be used for sprinkler piping. ASTM B88 TYPE -K copper pipe with brazed joints is acceptable.
L. Hangers, supports and bracing of system shall be in accordance with NFPA 13 requirements. In addition, specify ends of all branches 2½-inches and larger shall be sway braced, and ends of all branches less than 2½-inches shall utilize a splayed seismic brace wire.
M. All fire sprinkler piping shall be installed with an adequate slope to ensure that all portions of the system will drain. All auxiliary drains shall be extended to a visible and accessible location approved by the University Representative.
N. The drawings shall indicate where the system main drain shall discharge. Do not only note "to an approved location." Discharge to exterior is not permitted.
O. Signage for the FDC shall be white letters on Charles E. Young (CEY) brown background.
P. Water supply for fire protection systems shall not require metering.
Q. All exposed piping, backflow devices and supports shall be painted CEY brown.
R. No sprinkler piping or equipment shall be indicated in any electrical room, vault or areas designated for electrical or communication equipment, unless sprinkler piping is dedicated to serve such rooms.
S. Piping shall not be routed through electrical room, vault or other areas designated for electrical or communication equipment, unless piping will specifically serve such rooms.

PRE-ACTION FIRE PROTECTION SYSTEM

A. The pre-action system shall be Double interlock Self-contained with Single zone detection pre-assembled, pre-wired, and factory tested, confirming to CA Building code, OSHPD, SCFM, & NFPA 13, 25, 70, 72.
B. The integrated unit shall be c-UL-us Listed and FM Approved as an assembled unit. All system components shall be compatible, cULus listed or FM approved.
C. The system shall include a Deluge valve with a listed and approved supervised butterfly control valve & integrated anti-column device.
D. Systems provided with solenoid only, without mechanical latching device, shall not be accepted.

E. Piping shall be schedule 40 steel pipe with grooved ends & painted fire red.
F. Release trim with solenoid valves, pneumatic actuator, and every supervisory and alarm device required shall be Schedule 40 galvanized steel. Black pipe is not acceptable.
G. All pressure gauges shall be provided with its own three-way valve.
H. One dedicated branch circuit, 120VAC, 60Hz to power the releasing control panel.
I. One branch circuit, 120VAC, 60Hz for the optional air compressor provided inside the preaction cabinet.
J. Control panel requirements:
    a. There shall also be a disable switch to allow for maintenance and testing.
    b. When AC Power and DC power supplied by the back up batteries is lost, the system shall “fail-safe” and function as a dry pipe system.
K. Depending on the piping network's size, an accelerator device is required & shall be factory installed with a pressure gauge and bypass valve.
L. In areas where dry air is required, a dehydrator assembly is required & shall be factory installed in the air trim, with bowl guard, supply control and drain valves. Dehydrator shall be manually generated desiccant-type air dryer, the desiccant acting as a moisture indicator by changing color from dark blue to pink.

22 00 00
PLUMBING STANDARDS
JULY 2023

22 00 00 PLUMBING

220000 GENERAL REQUIREMENTS

A. DOCUMENT PREPARATIONS
1. Legends, schedules, and notes shall contain only items and information that are in the scope of work of that project.
2. The construction documents shall include riser-diagrams for each piping system, i.e. gas water system, process water system and hot water system.
3. All piping shall be sized and shown on the plan of the floor level in which it will be installed.
4. Adequately sized access panels must be designated for all concealed valves.

AS-BUILT DOCUMENTS

As-Built Drawings: In addition to requirements specified in Section 01 78 39, Project Record Documents: Record the following information on the As-Built Drawings:
   a. Locations of Work buried under or outside the building, such as plumbing and electrical lines and conduits. Furnish horizontal and vertical dimensions from fixed points.
   b. Actual numbering of each electrical circuit.
   c. Locations of all HVAC, plumbing and electrical Work concealed inside the building; and other work that is changed by Contractor from that shown on the Drawings.
   d. Locations of all items, not necessarily concealed, which vary from the locations shown on the Drawings.
5. Specifications shall be prepared to include only systems, items and materials that are in the scope of work for this project. Review and coordinate each specification section so there will be no contradicting information of specified items or materials. No work shall be called out in a manner which is not contractually enforceable.
6. A brief description shall be added to the front sheet outlining the scope of work.
7. Include all applicable codes, seismic codes and Cal-Green notes when applicable.
8. Include grid lines, north arrow and key map.

B. DRAWINGS AND CALCULATIONS
1. Show all calculations on drawings: hydraulic water calculations and pipe sizes, sump and sewage ejector pump size calculations, storage and hot water heater. Furnish prior to any CD submission
2. 1/4 inch scale or larger equipment, restrooms and shower rooms showing each major piece of plumbing equipment and fixtures.
3. Show pipe riser diagrams complete with pipes sizes and appropriate unit values: water fixture units, drainage fixture units, GPM, CFH, etc.
4. All equipment schedules must be shown on the plans, not on the specifications. The plans become the campus' permanent record, and are referred to for maintenance and operations purposes. The specification book is not a readily accessible record.
5. Specification title and numbering shall be based on Master Format (version as approved by University's Representative) and content shall be in CSI 3-part format (Part 1-General, Part 2-Product, and Part 3-Execution).
6. Plumbing specification sections shall have separate sections, independent of mechanical specification sections.
7. Plumbing details to be included in the plans (when applicable):

a. Equipment and piping supports including seismic bracing installed inside and outside the building. Include wind load for exterior installation.
b. Vibration isolation and seismic restraints
c. Pump piping detail
d. Heat exchangers and water heaters piping details
e. Manual air vent and automatic air vent details
f. Open type expansion tank
g. Bladder type expansion tanks
h. Equipment drains. Provide hose end connections to all drain valves. Drain valves above finished ceiling shall be provided with chained cap.
i. Cooling coil condensate drain piping
j. Concealed or exposed pipe penetrations through walls, floors and roof. Coordinate with the architect's drawing.
k. Injection Fittings (including injector and tubing) for chemical treatment of water piping system.
l. Underground storage tank
m. Equipment housekeeping pad

Nomenclatures

AD	Area Drain
AP	Access Panel
BP	Booster Pump
BT	Bathtub
BWV	Backwater Valve
CA	Compressed Air
CCA	Clean Compressed Air
CD	Condensate Drain
CO	Cleanout
CI	Cast Iron
CP	Circulating Pump
CW	Cold Water, Domestic
DF	Drinking Fountain
DFU	Drainage Fixture Unit
DI	Deionized
DI	Ductile Iron
(E)	Existing
ET	Expansion Tank
EWC	Electric Water Cooler
FCO	Floor Cleanout
FD	Floor Drain
FS	Floor Sink
FT	Flush Tank
FU	Fixture Unit
FV	Flush Valve
GALV	Galvanized
GI	Grease Interceptor
GPF	Gallon Per Flush
GPH	Gallon Per Hour
GPM	Gallon Per Minute
GRW	Grease Waste

GW	Gray Water
HB	Hose Bib
HW	Hot Water, Domestic
HWR	Hot Water Return, Domestic
ICW	Industrial Cold Water
IE	Invert Elevation
IRW	Irrigation Water
IW	Indirect Waste
KS	Kitchen Sink
LV	Lavatory
LV	Laboratory Vent
LW	Laboratory Waste
MH	Manhole
MS	Mop Sink
(N)	New
O2	Oxygen
OD	Overflow Drain (Secondary Storm Drain)
P	Pressure, Pump
PCW	Process Cold Water
POC	Point Of Connection
PM	Pressure Main, Sanitary Waste
PRV	Pressure Reducing Valve
PSI	Pound Per Square Inch
(R)	Relocated
RD	Roof Drain
RO	Reverse Osmosis
RPBP	Reduce-Pressure Type Backflow Preventer
RR	Roof Receptor/Sink
RW	Recycled Water (Reclaimed)
SD	Storm Drain
SE	Sewage Ejector
SF	Square Feet
SH	Shower
SK	Sink
SOV	Shutoff Valve
SP	Sump Pump
SS	Sanitary Sewer
ST	Storage Tank
T	Temperature
TMV	Thermostatic Mixing Valve
TYP	Typical
UR	Urinal
V	Sanitary Vent
VA	Vacuum
VB	Vacuum Breaker
VTR	Vent through Roof
W	Sanitary Waste
WC	Water Closet
WFU	Water Fixture Unit
WH	Water Heater
WHA	Water Hammer Arrester

SYMBOL	DESCRIPTION
	PIPE DOWN
	PIPE DROP
	TOP CONNECTION - BRANCH LINE
	BOTTOM CONNECTION - BRANCH LINE
	COLD WATER
	HOT WATER
	HOT WATER CIRC
SAN	SANITARY SEWER, WASTE OR SOIL BELOW GRADE OR FLOOR
SD	STORM DRAIN
	PIPING BELOW GRADE
	WASTE, OR SOIL ABOVE GRADE OR FLOOR
	VENT
RD	ROOF DRAIN PIPING, THE PIPES FROM ROOF DRAIN
OD	OVERFLOW DRAIN PIPING
IW	INDIRECT WASTE
G	NATURAL GAS
	POINT OF CONNECTION OR POINT OF DISCONNECTION
W	WASTE STACK
V	VENT STACKS
CW	COLD WATER RISER
HW	HOT WATER RISER
HWR	HOT WATER RECIRC. RISER
G	GAS RISER
RD	ROOF DRAIN RISER
OD	OVERFLOW DRAIN RISER
	PLUMBING EQUIPMENT
1 / P2	DETAIL NO. / SHEET NO.

LACTATION ROOM:

A. The lactation room shall be locked, private space that is sanitary, shall include HVAC system and equipped with a table, comfortable chair, and electrical outlet. If possible, the lactation space either shall be located near a source of running water or shall have a sink with running water in it.

LEED and SUSTAINABILITY

A. GREEN BUILDING POLICY COMPLIANCE
   1. All projects must comply with the UCLA Campus Green Building Baseline Standard and must meet the UC-equivalent of the USGBC “LEED Silver” with a target of Gold. A copy of the latest baseline standard shall be obtained by the designer. Some of the baseline requirements that have particular MEP impact include:

      a. Water efficiency and conservation in compliance with CalGreen.
      b. Gray water system, cooling coil condensate drain system and/or storm drain system shall be collected and treated on site as reclaimed water for toilet water flushing system and irrigation system.
      c. Each project will be required to perform a cooling coil condensate reclaim feasibility study. When feasible, Contractor shall be required to plumb, or otherwise, tie each cooling coil condensate line back to the Campus Condensate Reclaim system.
      d. In addition to the baseline requirements, each project must consider the additional USGBC LEED criteria that may be feasible to attain a minimum LEED “certified” rating for the project.

221116 PLUMBING WATER PIPING

A. GENERAL REQUREMENTS
   1. Campus water main supply pressure is 130 to 190 PSI. Provide multiple pressure-reducing valve assemblies as required.
   2. The Water leak detection alarm system is required in sensitive areas where high value equipment, information, or materials are present with an automatic shutoff valve & shall be tied into the BAS. Please Consult the University’s Representative for a determination of the automatic shut off valve requirements.
   3. Provide meters for domestic, industrial and irrigation water lines. Water line to fire protection systems is not required to be metered. Meter size shall be based on maximum and minimum flow requirements, not line size. Locate meter inside the building after pressure reducing valve assembly.
   4. Furnish hydraulic calculations and pipe sizing schedule based on water fixture unit counts.
   5. Maximum cold water pipe velocity shall be 6 fps; hot water supply shall be 5 fps; hot water return shall be 3 fps.
   6. Provide make-up water lines to mechanical hydronic system complete with reduced-pressure type backflow preventer assembly and pressure reducing valve as required. Provide quick-fill line and hose bib downstream of backflow.
   7. Provide make-up water lines to reclaimed water system complete with reduced-pressure type backflow preventer assembly and pressure reducing valve as required. Provide quick-fill line and hose bib downstream of backflow.

8. Water piping shall not be routed through electrical room, elevator machine room, telecom, and similar rooms.
9. Water piping shall not be routed under building slab.
10. Animal watering system (AWS) must be separated from the domestic water system with a reduced pressure principle device backflow preventer. The need for AWS and the quality of water to be utilized must be determined by the end users. Specific requirements for the zoning, number of water connections per room, control, etc. must be verified with the end users
11. “Dead leg” branches on water lines shall be cut back as close as possible to the mains or nearest active tee.
12. All types of underground piping shall be protected against corrosion in accordance with ASTM A674 or AWWA C105
13. All new construction with domestic hot water system shall have Sub meter, flow meter & BTU meter including all accessories with BMS connection. Please Consult the University’s Representative for a determination of the sub-metering requirements (secondary or tertiary meters) for a single building or multiple buildings within a single project. Please refer FM division 230000 metering standards.

B. PIPING MATERIALS
1. Pipe and Fittings:
   a. Hard drawn copper Type K, ASTM B88, permanently color marked with manufacturer’s trademark and country of origin. Type “K” shall be marked in green.
   a. Underground Water: Type K Copper with brazed joints. Underground pipe shall be protected against corrosion in accordance with ASTM A674 or AWWA C105.
   b. Aboveground Water: Type K Copper
   c. Fittings: Copper fittings shall be factory-made, wrought or cast pressure fittings and have integral formed pipe stops on each connection.
   d. Mechanical formed tee fittings utilizing mechanically extracted collars or brazed outlets shall not be used.
   e. Pro pressed fittings shall not be used for new construction and remodel projects.

C. VALVES
1. Several valve manufacturers carry separate domestic and import lines. The import lines are often of inferior quality. Where a specification refers to such a manufacturer, the specification writer shall verify that the valve model numbers specified are for the domestic made valves and not the import line of the manufacturer.
2. Ball valves shall be lead-free, full-port, stainless steel ball and stem. Chrome plated ball is not acceptable.
3. Up to NPS 2-1/2: Three-piece, threaded, bronze valve with stainless steel ball and stem, Nibco T-595-Y-66-LF or equal.
4. NPS 3 and larger: Carbon steel, split-body, stainless steel ball, flanged, Nibco F-515-CS-F-66-FS or equal.
5. All valves for future connection shall be capped or plugged. Drain outlets shall be piped to drain or plugged. Unplugged open valve ends will eventually leak and cause damage.
6. Soldered end valves are NOT ACCEPTABLE and shall not be specified except when factory installed as part of the equipment

D. DIELECTRIC FITTINGS
1. Use isolator fittings wherever ferrous and non-ferrous piping material are joined together. Conventional dielectric unions and couplings have been found to be unreliable. Only the

following will be accepted: use threaded M.P.S. minimum 3-inches long zinc electro-plated steel casing with inert NSF/FDA listed lining, ASTM F-492 rated at 225F, 300 psi, "Clear Flow" or equal. At Contractor's option, 6-inch long, brass nipple is also acceptable.

E. PRESSURE REDUCING VALVE
1. Up to NPS 2: Clay-Val all brass body with union FNPT inlet connection. A union shall be located on the discharge side of each valve in a vertical position.
2. NPS 2-1/2 and Larger: Clay-Val Pilot Operated Series 90 or equal.
3. All internal parts shall of Stainless steel material.

F. WATER HAMMER ARRESTERS
1. Water hammer arresters shall be all copper, piston type. Stainless steel bellow type is not acceptable. Provide shut off valves and access panel for arrestors.

G. EXECUTION
1. Piping Application.
   a. Water piping shall be hard copper tube, type K, ASTM B88.
   b. Fittings: Up to NPS 2 with system temperature up to 140°F, except underground, shall be wrought-copper solder-joint fittings, 95-5 tin-antimony, lead-free soldered.
   c. Fittings: Up to NPS 2 with system temperature above 140°F and all underground piping, shall be wrought-copper solder-joint fittings, lead-free Sil-Fos brazed.
      - Cut square, remove burrs and clean outside of pipe and inside of female fittings and to a bright finish with steel wool, wire brush, sandpaper or emery cloth. Apply solder flux with brush to tubing.
      - All soldered or brazed joints shall be made by a brazer currently certified for the size of pipe being brazed or for minimum 1-1/2-inch pipe. Certifying individual or agency shall in turn be certified by AWS.
      - All soldered or brazed joints shall be acceptable only if 100% full joint penetration of the soldering or brazing alloy is achieved.
      - All soldered or brazed joints shall comply with Section IX of ASME Boiler and Pressure Vessel Code.

   d. Fittings: NPS 3 and larger shall be cast-bronze or wrought-copper, mechanical-grooved fittings suitable for domestic cold and hot water, rated at 300 psi. All grooved mechanical fittings shall be with stainless steel nut & bolt.

2. Piping Installation.
   a. Water piping shall not be installed below any on-grade interior concrete floor slab; service pipe must rise to be above grade at the perimeter of the building. Island type fixtures will be supplied from overhead if possible, or through piping sleeves below the slab.
   b. Three (#3) pressure reducing valve station and water meter are required on all building water services (excluding fire protection). The campus standard is 2 inch and smaller Clay-Val all brass body with union FNPT inlet connection. A union shall be located on the discharge side of each valve in a vertical position. 2½" and larger shall be Clay-Val Pilot Operated Series 90. No by-pass shall be indicated. Campus

water main supply pressure is 90 to 190 PSI(Design professional to verify prior to design).

c. The water meter shall be cast bronze body, positive displacement, single jet, or turbine type. The meter shall have DDC compatible pulse type attachment for remote registering of flow in cubic feet, Backnet output for BMS connection and located on the low pressure side of the buildings PRV station.
d. A backflow device is not required for the domestic cold water building service, unless required by CCR Title 24 Part 5.
e. A backflow device is required for all types of Industrial water & BSL labs.
f. No equipment shall use domestic or industrial cold water for cooling when the water goes to drain; water may be used for cooling if it can be reused for other systems after cooling. Equipment cooling may be through a closed loop system.
g. Industrial water shall be supplied from the domestic water service through a reduced pressure type backflow preventer, which can be fully serviced without removing it from the line. All backflow devices shall be located in an area that is easily accessible for maintenance, with an adjacent receptor or floor sink of sufficient size to carry the drain off from the device.
h. Industrial hot water shall be generated in a separate heater and supplied from the industrial cold water system.
i. All domestic and industrial hot water piping shall be fully insulated and Title 24/CEC compliant. Return or circulating piping shall be sized for a three (3) F.P.S. maximum velocity.
j. Industrial hot and/or cold water shall supply all fixtures and equipment within laboratories or used for laboratory work (hoods, sinks, washers, etc).
k. Domestic hot and/or cold water shall only supply those fixtures used for sanitary purposes and food preparation i.e. water closets, urinals, lavatory, drinking fountain, pantry sinks, service sinks, emergency equipment, etc. Locating domestic water piping in laboratory or research areas shall be avoided except for eye wash fountains and emergency showers.
l. All plumbing fixtures and related equipment (flush valves) that are specified shall be designed to minimize water consumption.
m. Any equipment that requires a hot water supply shall be able to satisfactorily operate with 115°F hot water. A booster heater may be required if the 115°F temperature is not sufficient and therefor the equipment shall be able to operate within those temperature conditions.
n. All domestic and laboratory hot and cold water and fire lines up stream of the double check valve shall be disinfected. Refer to disinfection section specified below.
o. Shut-off valves shall be specified and indicated on the drawings to achieve isolation for each riser, group of fixtures, equipment's and branch mains.
p. Provide a "quick fill" on water make-up and an adjacent hose bib to each cooling tower and evaporative cooler.
q. Provide hose bibs on roof near mechanical equipment and building perimeter every 50 feet. Hose bibs on roof shall not be more than 50 feet from mechanical equipment.
r. Provide reduced-pressure type backflow preventer on make-up water lines to open and closed loop hydronic piping systems.
s. No piping shall be routed in any electrical room, vault or areas designated for electrical or communication equipment.
t. Underground wrapped piping shall require holiday test. Test shall be witnessed by the University's Representative.

H. Field Quality Control.
   1. Testing. The following tests by the Contractor are required for site water distribution systems.
      a. All testing and chlorination of new site water mains shall be done prior to the final connection to the existing University mains.
      b. Pressure test: After the pipe is laid, the joints completed and the trench partially backfilled, leaving the joints exposed for examination (center load the pipe), the newly laid pipe or any valved section of piping shall be subjected to a pressure test of 250 psi static pressure for a period of four (4) hours at the points of reading. Test shall be recorded using a Contractor-furnished Bristol recording device. Start and stop test in the presence of the University's Representative.
      c. Contractor to provide adequate thrust containment during testing. A blank flange (cookie) may be installed at system POC shutoff valve.
      d. Leakage test: Perform the leakage test in accordance with the requirements of American Water Works Association, Inc. (AWWA) Standard C-600.
      e. Contractor shall provide "tee" fittings (not hot tap) required to introduce and flush out the disinfectant agent. Saddle valve not permitted on mains for disinfection of domestic water. A mechanical fitting in an exposed section of pipe where routine inspection for leaks shall provide as a chlorination port.
   2. Disinfection of domestic water, industrial water, fire water and reclaimed water lines.
      a. General: All newly installed water systems and lines shall be disinfected by a Contractor-furnished commercial water line chlorinator. The commercial chlorinator shall also take water samples for bacteriological analysis. These samples shall be submitted to a California state licensed testing laboratory by the chlorinator.
      b. Incurred Costs: All expenses that may result from the disinfection and testing of water systems and lines, and the taking and analysis of water samples shall be borne by Contractor.
      c. Advance Notice: Contractor shall notify University's Representative and the UCLA Office of Environment, Health and Safety (EH&S), at least 72 hours in advance of all disinfection and testing procedures. All disinfection and testing procedures shall occur in the presence of an EH&S representative. Notification shall include location, number of chlorination's and tests, day and time.
      d. Labor and Materials: Contractor's chlorinator shall furnish labor, equipment, materials and transportation needed to correctly disinfect and test domestic and laboratory hot/cold water systems and fire lines and to take water samples for bacteriological analysis. This includes all items needed to facilitate the introduction of the disinfecting agent into the water systems/lines such as service cooks and valves.
      e. Disinfecting Agents: Chlorine is approved for water system disinfection and may be used in gaseous or liquid form. Other types of disinfecting agents may be used only with the prior approval of University's Representative.
      f. Disinfecting Procedure: The disinfection of water systems and lines shall be in accordance with the requirements of Title 22, California Code of Regulations (CCR) and the American Water Works Association (AWWA) standards. The disinfecting procedure shall include the following:
         - Post signs on all water outlets of the system being disinfected reading "Water System Being Chlorinated – Do Not Drink" or similar warning.
         - With system full of water and under "main" pressure, open all faucets to permit simultaneous trickle flow.
         - Introduce the disinfectant into the system until a test of the water at each outlet shows a free chlorine residual concentration of:

- 50 parts per million (ppm). This chlorine concentration shall be held in the pipes for a 24 hour period; or
- 200 ppm. This chlorine concentration shall be held in the pipes for a 3-hour period.
- The test made of the water after the retention time shall indicate a chlorine residual concentration of not less than half of the original concentration. Repeat the disinfection procedure until this standard is attained.
- After satisfactory completion of the above test, flush out system until diethyl-p-phenylenediamine (DPD) tests at the water outlets reveal that the free chlorine residual is less than 0.5 ppm or equal to the flushing water chlorine residual.

g. Water samples for Bacteriological Analysis:
   - Water samples for bacteriological analysis shall be collected by Contractor's chlorinator in sample bottles prepared as required by Title 22, CCR and AWWA standards. Samples shall be taken from a representative number of water outlets so as to ensure an accurate sampling of the water system/line. Water samples shall be taken in the presence of an EH&S representative (University may also collect a sample).
   - The water samples shall be delivered by Contractor's chlorinator in a timely manner to a California state approved water analysis laboratory. The samples must test negative for coliform organisms and less than 500 for a Standard Plate Count (HPLC).
   - If the results are positive, the above steps 6(a) through 6(e) shall be repeated. Two consecutive negative tests must be obtained prior to using the water system.

h. Final Results: Submit a copy of the laboratory analysis to the University's Representative and EH&S. If the analysis results do not meet the standards specified, the disinfecting procedure shall be repeated until the specified standards are met, at no additional cost to University. The complete procedure may take up to 4 days if negative results are obtained. This procedure will be longer if the results are positive.

221316 SANITARY WASTE AND VENT PIPING

A. GENERAL REQUIREMENTS
1. "Dead leg" branches on waste lines shall be cut back as close as possible to the mains or nearest active tee.
2. Where design and space permit, provide submersible type pumps in lieu of vertical wet pit type.
3. Minimum pipe size for vents through the roof shall be 3". Do not use 2½" pipe, use 3" pipes.
4. Air admittance valves not allowed. Venting shall terminate through the roof per CPC 906.0.
5. Cleanouts locations inside facilities: Campus Standards are more stringent than code and must be complied with.
   a. At each horizontal offsets
   b. At end of waste water or storm drains more than five feet in length
   c. At maximum 40 foot intervals of horizontal runs within the building.
   d. At base of vertical sanitary stacks.
   e. At each change of direction if the total aggregate change exceeds 90 degrees

f. Provide cleanouts flush with finished floor.
g. Above sanitary tees.
h. In vent piping above urinals or at end of a battery of urinals.
i. The cleanout cover, which should be made of brass or bronze, should be engraved with the letters "SS" to indicate it is meant for sanitary sewer purposes, and the letters "LW" to indicate it is intended for lab waste. The engraving should be done in a legible font.

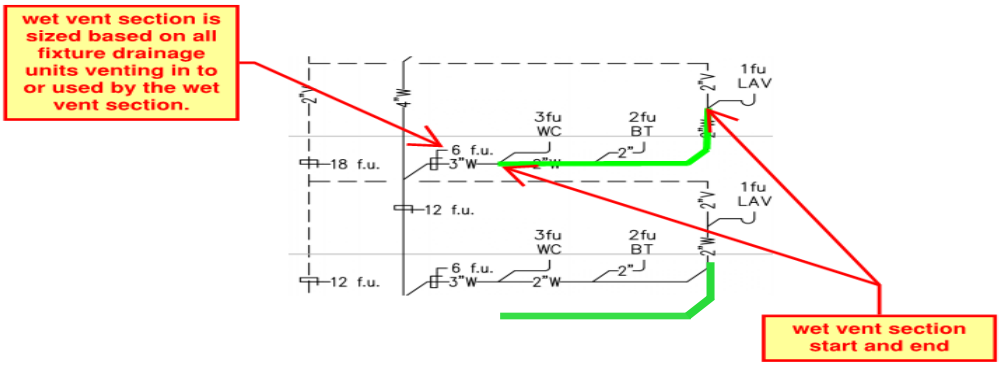
B. PIPING MATERIALS

1. Below Ground: Hub-and-Spigot, Cast Iron Soil Pipe And Fittings
   a. Pipe and Fittings: Service class, ASTM A74, and latest CISPI Standard 301.
   b. Gasket: ASTM C 564, neoprene

2. Above Ground: Hubless, Cast-Iron Soil Pipe and Fitting
   a. Pipe and Fittings: Service class, ASTM A888, and latest CISPI Standard 301.
   b. Couplings: Standard shielded stainless steel couplings, ASTM C1277, CISPI 310, with ASTM C 564 rubber sleeve.
   c. Couplings: Heavy duty, shielded stainless steel couplings, ASTM C1540, CISPI 310, with ASTM C 564 sleeve.
   d. Couplings: Heavy duty, cast-iron couplings ASTM A48 with stainless steel bolts and ASTM C564 rubber sleeve.
   e. No hub waste piping must use 4-band coupling. No hub waste vent piping may utilize 2-band couplings. Husky or equal.
3. The material used for the condensate pipe shall be Copper TYPE L-DWV. In cases where the condensate water is corrosive, the pipe material shall be stainless steel (SS).
4. Steel Pipe And Fittings
   a. Steel Pipe: Galvanized steel schedule 40, ASTM A53, seamless
5. Vents
   a. The vent shall be designed & installed by conventional vent system (each plumbing fixture trap shall be vented).
   b. Using of common vertical vent pipe per CPC 905.6 is allowed.
   c. Following vent design is prohibited in all types of construction.
      - Vertical Wet Venting
      - Combination Waste & Vent System
      - Circuit Venting

6. Horizontal Wet Venting (Allowed only for **R** occupancy)
   a. Per Section 908.2.2 of the 2019 California Plumbing Code (CPC), “the wet vent shall be sized based on the fixture unit discharge into the wet vent”. The wet vent however is also serving as the vent for the water closet. The fixture units for the water closets will have to be added those fixtures discharging into the wet vent to provide an adequately sized vent for the entire horizontally wet vent system.
   b. Per Section 908.2.2 states that “the dry vent shall be sized in accordance with Table 702.1 and Table 703.2 based on total fixture units discharging into the wet vent.” The dry vent is also serving as the vent for the water closet which would require the fixture units discharging into the wet vent to be added the fixture units for the water closet to provide an adequately sized vent for the entire wet vent system.

Example: Note, the wetted vent section is 3 inch per UCLA Authority Having Jurisdiction.



7. Suds Relief
   a. Provide additional vent connection at the base of stack above the suds pressure zone.

C. EXECUTION
1. Earthwork. Backfill material for site utilities below paved areas (streets, parking lots, walkways) Sand shall be 12 inch above pipe then backfilled with 1.5 sack cement slurry up to sub-grade elevation. In planting areas, Sand shall be 12 inch above pipe, then backfilled with compacted native soil to finished grade. Refer to Campus Site Utilities Standard for additional information.

2. Piping Application.
   a. Gravity Sanitary Waste Pipes and Fittings: Interior pipe and fittings below floor slab on grade shall be cast iron. Pipe and joints shall be hub and spigot with neoprene gasket, and comply with the latest issue of ASTM. Standards A888 and A-74. Stainless steel couplings shall not be specified below grade. Piping above grade may use hubless stainless steel couplings.
   b. All cast iron pipe shall comply with the latest issue of C.I.S.P.I. Standards 301 and 310 and be stamped with C.I.S.P.I. trademark and listed by NSF International.
   c. Pressure Main Sanitary Waste Pipes and Fittings: Underground and below ground pump discharge shall be DWV copper pipe and fittings with solder joints. Hubless piping shall not be specified.
   d. Pressure Main Sanitary Waste Pipes and Fittings: Above ground pump discharge piping shall be schedule 40 galvanized pipe with cast iron drainage pattern screwed or mechanical coupling fittings. Hub-less piping shall not be specified.

3. Piping Installation.
   a. Dead leg branches on waste lines shall be cut back as close as possible to the mains.
   b. Provide a two-way cleanouts & Jetter Access Point on waste exiting the building
   c. Underground pipe shall be protected against corrosion in accordance with ASTM A674 or AWWA C105.
   d. Provide floor drains with trap primers in areas that are not expected to be constantly wet, such as toilet and mechanical rooms. There shall be at least one 3-inch

minimum size floor drain with 3" trap located in each mechanical room or area where wet pipes are installed. Floor sinks shall be sized to accept all indirect waste G.P.M. flow, minimum waste size shall be 3-inch.

e. In addition to hangers at each fitting, horizontally run hubless cast iron piping shall be supported independent of couplings. This means that there must be a support on each side of a coupling on straight runs of pipe.
f. Support shall be indicated for each suspended cast iron trap.
g. Horizontal hubless pipe of any size, system or material utilizing a shield type joint shall be braced, where hanger rods exceed 12 inches in length. Bracing shall be installed a maximum of 40 feet on center.
h. Projects that include food preparation facilities shall include a grease interceptor within the scope of the work. Design shall comply with California Plumbing Code Appendix H. Below slab on grade waste piping in food preparation areas shall be acid resistant type (same as laboratory) extending to a point where there will be adequate dilution with the building's sanitary drainage system.
i. Provide a separate waste and vent system serving laboratory fixtures and equipment. The symbol designation shall be Laboratory Waste (LW) and Laboratory Vent (LV). The terms Acid Waste or Acid Vent shall not be used.
j. Indirect waste receptors shall be provided for all roof mounted HVAC equipment (condensate). Receptors shall be piped to the sanitary waste systems. Do not spill on to roof or run drain piping exposed on roof.
k. Laboratory Waste Piping
   - Above Grade: Lab Waste on the campus shall be borosilicate glass pipe or Spears CPVC Lab Waste & fittings.
   - Below Grade: Lab Waste on the campus shall be Spears CPVC Lab Waste & fittings.
l. If the designer recommends use of materials other than glass, this shall be justified for the particular project based on analysis of the risk as well as the cost reduction. University accepted plastic pipe is Spears CPVC Lab Waste, Enfield Lab Waste or IPEX PlenumLine PVDF. Joints in plastic systems shall be solvent cement or electrofusion type.
m. Lab waste vent through roof shall not be glass pipe.
n. University Fire Marshal approval is required for combustible (plastic) piping. The University Fire Marshal may require insulation (wrapping) of unrated plastic piping to comply with smoke development ratings, and listed fire stops through rated walls or floors.
o. Provide a minimum of 4" waste pipe size to each animal holding room. Waste from animal holding rooms shall have more than code required clean outs because of the potential for debris in these lines. Where movable fume hoods are used, they shall discharge into an approved corrosion resistant floor sink through an approved air gap.
p. The independent laboratory waste piping shall run to a sampling pit or manhole located exterior to the building. Laboratory waste and sanitary waste may combine downstream of the pit or manhole. Detail of the pit or manhole shall comply with all requirements of Los Angeles County Industrial Waste Division.
q. For drainage systems beneath building slabs, a re-test shall be specified after backfill but before slab placement to assure that pipes have not been damaged during backfill or compaction.
r. As required by ucla standards, no piping shall be routed in any electrical room, vault or areas designated for electrical or communication equipment.

s. Sewage Ejectors: Where design and space permits, provide submersible type duplex pumps with spare in lieu of vertical wet pit type. Pump motor shall be on top. In high temperature applications such as vivarium, cage washing; hi temp. floats shall be provided. Pipe material shall be SS in lieu of CI.

4. Field Quality Control.
   a. The Contractor shall be required to video tape all new sanitary sewers, storm drains and manholes at the end of the project. Taping shall be done in the presence of the University Representative and a copy of the video given to the University as part of the record drawing requirement.

221400 FACILITY STORM DRAINAGE

A. GENERAL REQUIREMENTS
   1. Building roof drain and piping system is to be designed based on a rainfall intensity of 3-inches per hour.

B. PRODUCTS
   1. Below Ground: Hub-and-Spigot, Cast Iron Soil Pipe And Fittings
      a. Pipe and Fittings: Service class, ASTM A74, and latest CISPI Standard 301.
      b. Gasket: ASTM C 564, neoprene

   2. Above Ground: Hubless, Cast-Iron Soil Pipe and Fitting
      a. Pipe and Fittings: Service class, ASTM A888, and latest CISPI Standard 301.
      b. Couplings: Standard shielded stainless steel couplings, ASTM C1277, CISPI 310, with ASTM C 564 rubber sleeve.
      c. Couplings: Heavy duty, shielded stainless steel couplings, ASTM C1540, CISPI 310, with ASTM C 564 sleeve.
      d. Couplings: Heavy duty, cast-iron couplings ASTM A48 with stainless steel bolts and ASTM C564 rubber sleeve.
      e. No hub waste piping must use 4-band coupling.

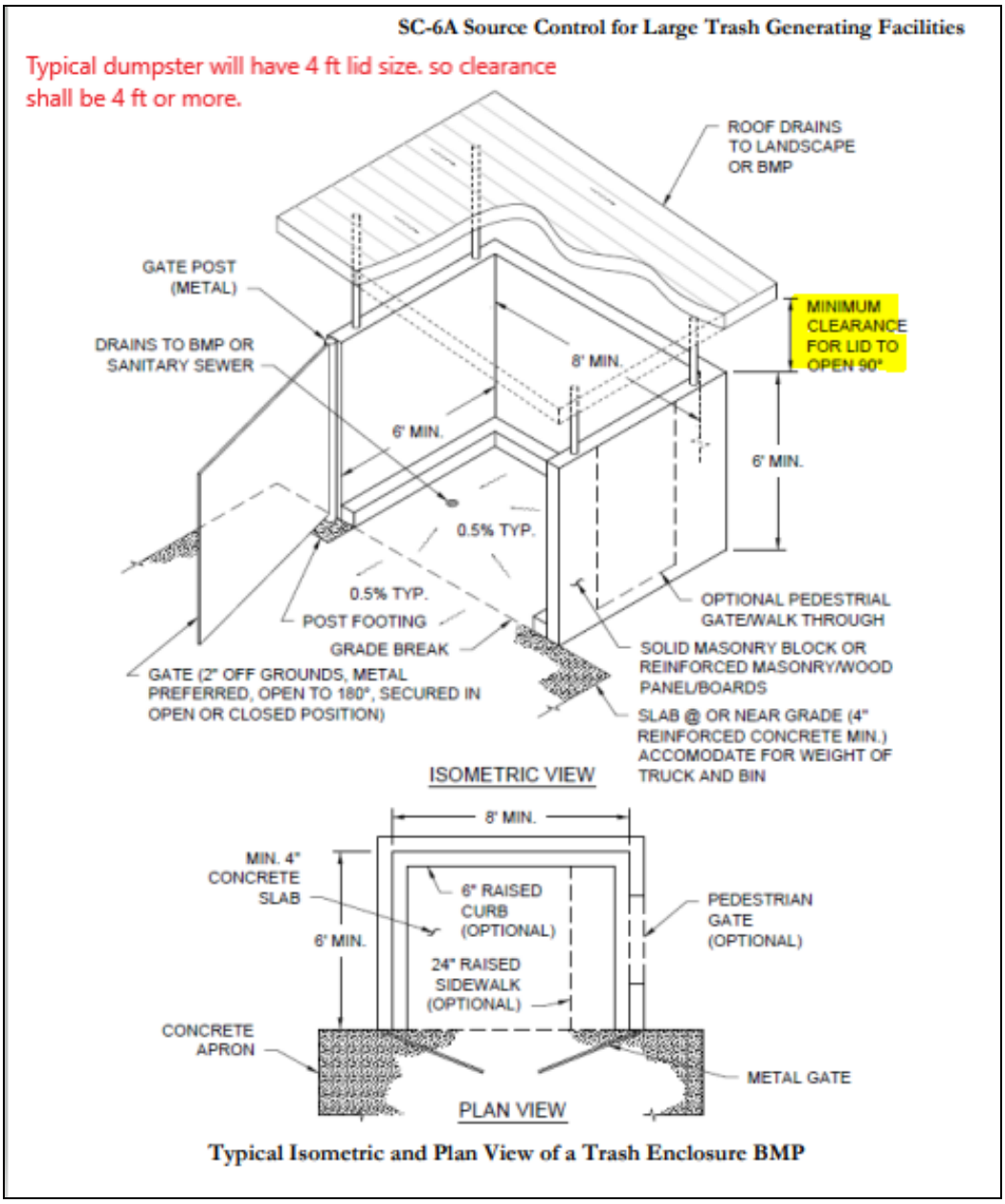
C. EXECUTION
   1. Earthwork. Backfill material for site utilities below paved areas (streets, parking lots, walkways) Sand shall be 12 inch above pipe then backfilled with 1.5 sack cement slurry up to sub-grade elevation. In planting areas, Sand shall be 12 inch above pipe, then backfilled with compacted native soil to finished grade. Refer to Campus Site Utilities Standard for additional information.

   2. Piping Application.
      a. Interior pipe and fittings below floor slab on grade shall be cast iron. Pipe and joints shall be hub and spigot with neoprene gasket, and comply with the latest issue of A.S.T.M. Standards A888 and A-74. Stainless steel couplings shall not be specified below grade. Piping above grade may use hubless stainless steel couplings, and comply with the latest issue of C.I.S.P.I. Standards 301 and 310 and stamped with C.I.S.P.I. trademark.

3. Piping Installation.
   b. Piping shall not be encased in concrete or masonry walls or floor slabs. Taping and or foam wrapping of pipe and fittings does not constitute a code or university approved method of separation.
   c. Underground pipe shall be protected against corrosion in accordance with ASTM A674 or AWWA C105.
   d. In addition to hangers at each fitting, horizontally run hubless cast iron piping shall be supported independent of couplings. This means that there must be a support on each side of a coupling on straight runs of pipe
   e. No piping shall be routed in any electrical room, vault or areas designated for electrical or communication equipment.
   f. Sump Pumps: Where design and space permits, provide submersible type duplex pumps with spare in lieu of vertical wet pit type. Pump motor shall be on top. In high temperature applications such as vivarium, cage washing; hi temp. floats shall be provided. Pipe material shall be SS in lieu of CI.

4. Field Quality Control.
   a. The Contractor shall be required to video tape all new sanitary sewers, storm drains and manholes at the end of the project. Taping shall be done in the presence of the University Representative and a copy of the video given to the University as part of the record drawing requirement.

5. Trash enclosure requirements:
   To prevent trash enclosure from contributing to storm water runoff pollution, all enclosures must be fitted with a roof designed to drain into on site landscape areas (where necessary) and / or to appropriate BMP's. The roof must provide sufficient clearance to allow the dumpster lid to open to the 90 degree position.



224000 PLUMBING FIXTURES

A. Water Closet:
   1. General Requirement :
      a. Height of flushometer valve shall allow for maintenance in location with ADA grab bar.
   2. Performance Requirement:
      a. Provide vitreous china, siphon jet action, Maximum Performance (MaP) tested by IAPMO to exceed 500g capacity.
      b. Flushometer: Exposed, diaphragm-type, manual 1.28 / 1.1 gallons per flush (GPF) flush valve with sensor operated battery powered retrofit kit

c. Seat: White, heavy-duty, commercial type, elongated, open front, solid plastic, with stainless steel hinge.
d. Water closet carrier: High performance , adjustable water closet carrier, 500-lb load or equal

3. Products:
   a. Water Closet: American Standard AFWALL millennium flowise elongated toilet or equal.
   b. Flushometer: Provide sensor flush valve for ADA stalls, Private offices, and medical areas & provide a manual flush valve for all public & student restrooms.
      Manual: Sloan royal flushometer 111.12
      Sensor: AMTC Model AEF-801-CT-11 or equal.

B. Urinals:
   1. General Requirement :
      a. Urinal shall be accessible.
      b. For renovations, existing piping network shall be evaluated for pipe size and slope.
   2. Performance Requirement:
      a. Wall hung, vitreous china retrofit hybrid urinal
   3. Products:
      a. Sloan Standard urinal model HYB-1000 or HYB-1000 RET equal.

C. Wall-hung lavatory:
   1. General Requirement :
      a. Visible traps shall be chrome plated unless project requires special finishes.
   2. Performance Requirement:
      a. 4 inch center vitreous china, with concealed carrier arm.
      b. Sanitary waste traps for equipment shall be “P” type, 17 gauge, cast brass, slip joint nuts, chrome plated brass escutcheons and cleanout plug.
   3. Products: American standard or equal
      a. Lavatory Faucets: All lavatory faucets shall be specified as metering or sensor type. 0.5 GPM flow rated or equal.
         Manual/Metering: Chicago 3501, 3502 - 4E2805ABCP series or equal.
         Sensor: Sloan EAF-150-BAT-ISM-0.5/0.35GPM-MLM-IR-FCT series, AMTC AEF-301 or equal.

D. Drinking Fountain:
   1. General Requirement :
      a. Drinking fountains shall installed, provide with an integral bottle filling station.
   2. Performance Requirement: The unit shall be lead free; non filtered non refrigerated.
   3. Products:
      a. Drinking Fountain: Murdock Bi-Level Fountain, Non-Filtered Non-Refrigerated Stainless Steel without bottle counter display MODEL A132400S-VR-BF4, MA172400S-A008, MA171400-A008 or equal
      b. For UCLA health and Asset management projects DF & BF may be use refrigerated products. Please contact university representative for the exact model and use of such.

E. Bottle Filler:
   1. Products: Murdock Non-Filtered Non-Refrigerated Stainless Steel with bottle counter display Model A0000000-BF4, BF2SC or equal

F. Angle Stop:
   1. General Requirement: IPS threaded inlet, quarter turn, loose key, chrome-plated all brass, lead-free, Chicago or equal. Threaded pipe nipple shall be I.P.S. brass or copper pipe adapter shall be sweat x MIP. Compression fittings are not permitted.

G. Traps:
   1. General Requirement: L.A. pattern, chrome-plated, heavy-duty cast brass, adjustable, ground union joint elbow and cast brass slip nuts, without cleanout. Trap arm extension shall be I.P.S. threaded brass nipple.
   2. Product: McGuire or equal.
   3. Insulation: Pre-molded PVC covering conforming to ADA regulations. McGuire, Truebro, or equal.

H. Mop Sink:
   1. General Requirement :
      a. Floor mounted or wall mounted stainless steel sink.
   2. Performance Requirement:
      a. Full height tile/SS Splash guard around mop sink is required
   3. Products: Chicago faucet or equal
      Faucets: Wall-mounted manual sink faucet. Chicago 897-CCP with vacuum breaker or equal.

I. Trap Primer:
   1. General Requirement :
      a. Electronic trap primer with access panel
   2. Performance Requirement:
      b. Bronze / Copper Body, Distribution unit shall be of DU-4 type, plastic body TP & solenoid valve is not allowed.
   3. Products: PPP or equal

J. Floor Drain & Floor Sink:
   1. General Requirement
      a. Provide at least one floor drain in each multiple fixture toilet room near the water closet(s). Multiple fixtures are two or more WC or a combination of WC and Urinal.
      b. Provide floor drains in mechanical rooms in addition to any floor sinks required for specific equipment.
      c. Provide floor sink with minimum of 10” depth.
      d. Provide floor sinks within 5'-0" of mechanical equipment which has water connections or needs drains for condensate or humidifiers.
      e. Animal room drains shall have an 8” diameter strainer with a 4” trap with integral clean out. Provide floor sinks for indirect waste. Floor sinks shall be provided with at least a half grate.
      f. For deionized & condensate water discharge piping and floor sink shall be SS material.
      g. All labs must have oversized floor drain. Typically twice of the normal requirement.

K. Hose Bib:
   1. General Requirement: Exterior hose bibs shall be provided at new buildings and plazas to wash down walks, loading docks and drives Recessed wall box type with loose key stop and vacuum breaker shall be used on buildings.
   2. Exterior HB: Provide 100 ft maximum spacing along exterior walls. Shall be vandal proof & CP rough brass.
   3. Interior HB: Shall be chrome plated brass.

L. Laboratory sinks, general purpose:
   1. Performance Requirement: Epoxy resin, under-counter mount, chemical resistant.
   2. Faucet: Deck-mounted, gooseneck spout, replaceable stainless steel seats, built in stops; self-closing for D.I. application.
   3. Product:
      Sink: Durcon or equal
      Faucet: Chicago, Chicago water Saver or equal
   4. Plastic body parts not allowed.

M. EXECUTION

   1. Fixture Application:
      a. All plumbing fixtures shall be furnished complete with all necessary supports, hangers, trim and accessories to insure the specified installation and operation of each fixture. Trim and accessories shall include stops, supply pipes, drains, strainers, tailpieces, P-traps, escutcheons, wiring and conduits, and bolt caps. All exposed items and piping shall be chrome-plated.
      b. All lavatory faucets in public restrooms shall be specified as metering or sensor type.

   2. The following text shall be included in the fixture section of the specification:
      a. All plumbing fixtures shall be furnished complete with all necessary supports, hangers, trim and accessories to insure the specified installation and operation of each fixture. Trim and accessories shall include stops, supply pipes, drains, strainers, tailpieces, P-traps, escutcheons, and bolt caps. All exposed items and piping shall be chrome-plated.
      b. All fixture stops shall be quarter turn, loose key, all brass with I.P.S. threaded inlet. Threaded pipe nipple shall be I.P.S. brass or copper pipe adapter shall be sweat x M.I.P. Compression fittings are not permitted. Manufacturer shall be Chicago Faucets, Brass Craft “KT” Series, or equal.
      c. Supply pipe risers shall be rigid copper tubing ASTM B-68 with brass nuts or couplings.
      d. All traps shall be heavy gauge, L.A. pattern, cast brass, adjustable ground union joint elbow and cast brass slip nuts. Trap arm extension shall be I.P.S. threaded brass nipple. Traps shall be certified by CSA, marked with manufacturer’s name and testing agency.
      e. Water stops, risers and trap assembly shall be insulated with pre-molded PVC covering conforming with ADA regulations. Manufacturer shall be McGuire Prowrap, Truebro, or equal.

224300 HEALTHCARE AND LABORATORY PLUMBING FIXTURES

A. All faucets and valves for water service shall have Monel stainless steel stems, seats, and EDPM seat washers in waterway. The faucets shall be manufactured from brass construction. Brass components, which contact water within the faucet, shall be from brass, which contains no more than 3% lead by dry weight. There shall be no operating parts made from plastic or ceramic.
B. Valves shall close with the assistance of, not against, water pressure. Stems shall have ACME thread with o-ring to keep lubricant intact and shall have FDA approved seals. Stems shall be self-contained operating cartridge that allows for repair ability.
C. All parts shall be interchangeable among all faucets and valves for water service. Handle broach on upper valve stem shall be 4 point tapered broach to prevent handle from stripping and to allow ease of handle removal. All water faucets shall meet NSF Standard 61 section 9 for drinking water faucets and shall be certified by Underwriter's Laboratory. Product cartons shall feature the UL logo signifying certification of NSF 61 section 9.
D. Valves shall be capable of being converted to self-closing and slow closing without changing faucet body. Faucets shall be Factory tested at a minimum pressure of 125 psi.
E. Gooseneck spouts shall have double o-ring and be field convertible from swing to rigid. Spout shall be able to be swing or rigid as standard without changing faucet body. Spouts shall be completely interchangeable among all faucets.
F. All faucets and valves for water service shall be ADA compliant and be by one manufacturer. A full stock of repair parts shall be maintained locally in the Los Angeles area.

224500 EMERGENCY PLUMBING FIXTURES

A. Emergency Plumbing Fixtures (Eyewash unit and showers)
    1. General requirement:
        1. Supplied by domestic water.
        2. Hand-held drench hoses are not considered eyewash units.
        3. Eyewash and shower head shall be of SS, Plastic is not allowed.
        4. Emergency eye wash stations utilizing a spray hose, shall be furnished with a CCR Title 24, Part 5 approved backflow device.
        5. Type of device shall conform to location with respect to discharge, or release of water due to testing, pressure fluctuations, or backflow conditions.
        6. Devices which discharge water shall not be located below or within cabinets. Atmospheric vacuum breakers shall be located above the top of the cabinet.
        7. Provide emergency eye wash station in mechanical rooms near the chemical water treatment equipment.
        8. A separate floor drain is not required for emergency shower or eyewash.
        9. Use of hot water with a mixing valve for tepid water is not required.
        10. All types of emergency fixtures Including corridors and publicly accessible shall have alarm system consisting of visual and audible signal. Remote monitoring is not required.
    2. Consult the University's Representative for selection of the appropriate type(s) from the following:
        1. For laboratory units installed at sinks, provide eyewash unit which swings spray head assembly over sink activating continuous flow of water.
        2. For Barrier Free units, provide wall-mounted, low-profile eyewash with plastic receptor and aluminum wall bracket.

3. For recessed units, provide swing down eyewash in a fully recessed wall mounted stainless steel cabinet with drain pan.
4. Hand held drench hoses are not considered eyewash units. They may be used in addition to equipment, which is described as meeting the ANSI standard above. In some cases, a sink-mounted eyewash and a drench hose may be installed in lieu of a combination eyewash/safety shower. Consult the University's Representative for coordination with EH&S for review and approval of this configuration.
5. Mounted such that the water nozzles are 33 inches to 45 inches from the floor level and spray head height shall be below 36-inches and 17 to 25-inches from bowl edge, wall, or obstruction; height should comply with Americans with Disabilities Act of 1990 (ADA) requirements and at least 34-inches of clearance around the eyewash must be maintained.
6. Mounted such that spray nozzles, when activated, are no more than 18 inches from the counter front when located above work counters or benches.

3. Performance Requirement: Shall meet the performance and installation requirements of the American national standard institute (ANSI) Z358.1

4. Products: Guardian or equal

226000 GAS AND VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

A. Compressed Air System & Vacuum System
   1. General requirement:
      a. Identify the design and installation requirements for compressed air quality, dew point, pressure, flow, and volume to meet project specific requirements.
      b. Buildings utilizing compressed air for laboratory functions and HVAC systems shall have separate compressors.
      c. Provide valves at each point of connection to the main. Provide additional service valves at each piece of equipment.

   2. Performance Requirement:
      a. Piping: Type "K" copper tubing, hard drawn. Pipe shall comply to ASTMB819, be permanently color marked with manufacturers trademark and country of origin. Type "K" shall be marked in green.
      b. Joints: All joints shall be brazed. Refer to copper piping mechanical systems at front section of this standard for type of fittings and joints
      c. Valve: Ball Type
      d. Lab Air Outlets: All outlets shall be solid brass ball valve, ADA compliant color coded handle, polished chrome finish with 3/8 NPT male thread inlet, integral check valve and removable serrated hose nozzle, working pressure of .5-125 psi. Comply with ANSI Z21.5a.
      e. There shall be a shut-off valve for each system located in an accessible location in or adjacent to the cabinet with multiple system outlets.

226700 PROCESSED WATER SYSTEMS FOR LABORATORY FACILITIES

A. Processed Water System
   1. General requirement:
      a. Research Grade Water Systems may include but not limited to carbon filters, water softeners, reverse osmosis units, ion exchange systems and ultraviolet light disinfection systems with utra-filtration capabilities. Project specific requirements will consider water quality, water quantity, water pressure, water volume and flow. The Architect, in association with the University Project Engineer, shall meet with the laboratory user to determine which type/grade of ASTM water is to be used. The Project Engineer shall provide the definition of the ASTM Type I, II, III grade water for wet chemistry and biology laboratories. Electronics laboratory research grade water requirements shall be defined differently. All research grade water systems shall be tied into the BAS to alarm on low tank water level condition, low water quality, and on "no flow" conditions.
      b. Water leak detection alarm system is required with an automatic shutoff valve & shall be tied into the BAS.

   2. Performance Requirement:
      a. Reverse Osmosis systems shall have a regenerating type of softener with backwashing carbon filters in lieu of exchange bottles.
      b. The entire DI system shall be recirculating; no ‘dead legs’.

B. Ultra-Pure Deionized System
   1. Performance Requirement:
      a. The system shall be recirculating through deionized polishing bottles.
      b. Piping, joints and fittings:
         Type – I: unpigmented (natural) polypropylene, copolymer Type 1, Schedule 80 socked fusion.
         Type – II&III: Spears Low Extractable Product (formally known as LXT®), solvent cement joints.
      c. Provide 3M fire barrier plenum wrap 5A at specified PVC / PP piping in mechanical plenum.
      d. The entire system shall be sterilized.

Table 1: Water Quality and Equipment

Description	Use:	Quality	Equipment:	Piping:
Softened Water	Process equipment, dishwashing, cage-washing	A minimum of 95 percent of TDS removed	Softener / anti-scale chemical injection	Copper-Type K
Softened+ R.O.	Process equipment, consumption, feed water for D.I. system	5 percent or less of TDS and bacteria; 1-3ppm; approx. 0.5 megohm	In addition to above: - Carbon Filter - R.O. Prefilter - R.O. System	Copper-Type K
Softened + R.O. + D.I.	Laboratory grade for non-critical purposes; lab equipment connections; Type I feed water	Type II or III, per ASTM D1193-6;	In addition to above: - UV Sterilizers - 0.2 micron vinyl filter - Mixed bed De- Ionization bottles - Resin Trap - Storage Tanks - Distribution Pumps	Schedule 80 Spears low extractable product (LXT) or equal

Softened + R.O. + Ultra-pure D.I.	Critical laboratory applications; research/ medical grade	Type I, per ASTM D1193-6	In addition to above: - Polisher	Hi-purity polypropylene Socket Fusion

C. EXECUTION

1. Piping Installation.
   a. Install sectional valves close to mains on each branch and riser serving equipment.
   b. Install shutoff valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
   c. Locate valves for easy access and provide separate support where necessary.
   d. Install valves of same size as the pipe or tube in which they are installed unless otherwise indicated.
   e. Install valves of the same material as the pipe in which they are installed.
   f. Back pressure regulator valve shall be of stainless steel type Jordan mark 50 or equal.

227000 SPECIAL ROOMS

A. Mechanical rooms shall have a floor drains with trap primer, connect to the sanitary sewer.
B. Laboratory fume hoods shall use industrial water if available, to supply water to hoods. If a potable water supply fixture is located inside the hood enclosure, a double check valve backflow preventer shall be provided on the supply line outside the hood. Vacuum breakers shall not be used inside the hood without a double check valve backflow preventer
C. Lactation space either shall be located near source of running water or shall have a sink with running domestic hot & cold water in it.
D. Elevator pit drainage is required for each elevator. For example, if three elevators are in one pit, three floor drains are needed. Floor drain shall connect to the nearest manhole through an indirect connection. Elevator pit drainage line shall be separate, and no other plumbing fixture shall connect to the drainage line serving the elevator pit. Additionally, It shall also be in accordance with CBC chapter 30, ASME 17.1 & CCR Title 8, Elevator Safety Orders, 3120.6.

228000 SPECIAL REQUIREMENTS AND CONDITIONS

GREY WATER SYSTEM

A. Project specific requirements will consider location of a skid unit (above grade or below grade), primary and secondary filter, water pressure and material.
B. Grey water system must have a bypass connected to gravity system.
C. A Water leak detection alarm system is required with an automatic shutoff valve & shall be tied into the BAS.
D. The skid packaged unit shall not have plastic pipe material.
E. The skid packaged unit & storage tank location shall be above grade and offsite.
F. Pre filter and multimedia filter shall be of adequate size to remove the debris.

CRYOGENIC LIQUIDS AND LIQUEFIED GASES

A. Piping system shall be in accordance with NFPA 55 & ASME 31.3. Piping material shall be stainless steel or copper with brazed joints.

PLUMBING PUMPS

A. A domestic hot water recirculating line with a circulation pump shall be provided for domestic hot water systems when the farthest fixture is greater than 50 ft. from water heater. Where recirculation is provided, provide automatic flow limiting valves in the branch circuits. Provide flow limiter with shut off valve and strainer.
B. SUMP PUMPS pump on, off, lead, lag, and maximum effluent level shall be specified as calculated based on basin size to allow for efficient pump run times. These values shall be pre-determined and not field verified set points. Level control shall maintain the effluent level to 2 inches below the invert of the gravity drain. Sump pumps shall be on BAS.

DOMESTIC WATER HEATER

A. The following domestic hot water temperatures shall be used for design purposes.

ROOM SERVED	DESIGN TEMP.	SITE SETTING
Toilet room, Janitor Closet	110°F	105°F
Showers	120°F	110°F
Laboratories	120°F	110°F
Kitchen & Laundry facilities	140°F	140°F
Entering water temperature	60°F Varies	--------

B. Water heaters shall be set at 140° F. and provided with mixing valves to distribute water at lower temperature required.
C. Provide water heater with pressure and temperature relief valve piped full size of outlet to an indirect drain. Provide an expansion tank in the cold water pipe between the water heater and the pressure regulating valve.

NATURAL GAS PIPING

Underground: PE, Natural Gas Pipe: ASTM D2513, SDR 11; FM approved, with minimum thickness equivalent to Class 150.

Above ground: Standard weight Schedule 40 black steel pipe with 150 pound malleable iron

fittings for piping, 1.5 inch and smaller. Provide welded fittings for all piping larger than 1.5 inches and piping in vertical shafts, and mechanical and utility rooms.

VALVES:
1. Service: 125 lb. gate valve.
2. Bench Valves: Ball type with tapered sockets with ball and seat compatible with piping materials. Provide valve operating wrenches.
3. Gas Shut-off Valves: Earthquake-sensitive gas shut-off valve certified by the Division of the State Architect as conforming to Title 24, CCR.

METERS:
1. General requirement: All new construction/major addition/renovation shall provide with gas submeter for each building downstream of SoCal gas meter. The submeter shall be capable of tie into university BMS system. Consult the University's Representative for a determination of the sub-metering requirements (secondary or tertiary meters) for a single building or multiple buildings within a single project.
2. Product: Dresser root or equal

FLEXIBLE CONNECTIONS: 3/4 inch by 12 inches long stainless steel hose and braid.

23 00 00
HVAC STANDARDS
July 2023

23 00 00 HVAC

230000 GENERAL REQUIREMENTS

A. DOCUMENT PREPARATIONS
1. Legends, schedules, and notes shall contain only items and information that are in the scope of work of that project.
2. The construction documents shall include riser-diagrams for each piping system, i.e. chilled water system, process cooling water system, steam and space heating hot water system.
3. All piping shall be sized and shown on the plan of the floor level in which it will be installed.
4. Show on the plans, composite building sections, as needed to verify that all components will fit as shown on the plans. Indicate ducts, pipes, conduit, fan coils units, recessed light fixtures, structural beams soffits etc. at each critical location where such elements cross.
5. Adequately sized access panels must be designated for all concealed valves, electrical devices in support of HVAC equipment and for the largest replaceable device serving any HVAC equipment.

AS-BUILT DOCUMENTS

As-Built Drawings In addition to requirements specified in Section 01 78 39, Project Record Documents: Record the following information on the As-Built Drawings:

a. Locations of Work buried under or outside the building, such as plumbing and electrical lines and conduits. Furnish horizontal and vertical dimensions from fixed points.
b. Actual numbering of each electrical circuit.
c. Locations of all HVAC, plumbing and electrical work concealed inside the building; and other work that is changed by Contractor from that shown on the Drawings.
d. Locations of all items, not necessarily concealed, which vary from the locations shown on the Drawings.

6. The following requirements for As-Built Drawings are in addition to those specified elsewhere:
   a. As-built conditions shall be carefully and neatly recorded using methods acceptable to University's Representative. Final Drawings shall be submitted in PDF format, AutoCAD, REVIT and shall match size of the original Contract Drawings, and shall comply with the following:
      - University's Design Professional's name and stamp shall be removed from each drawing.
      - Add Contractor's name and contact information on each drawing.
      - Add "AS-BUILT" to the lower right area of each drawing.
   b. They shall be kept up to date during the entire progress of the work and made available to University's Representative at any time.
   c. Additional drawings shall be furnished as required to accurately describe changes.
   d. Record all changes in size, location, and other features of installation shown on the Drawings.
   e. Record all locations of underground work, points of connection, valves, manholes, catch basins, capped stub outs, invert elevations, etc.
   f. Record work concealed in, under or outside the building with accuracy.

7. Shop Drawings: Furnish final Shop Drawings which have been updated to show actual conditions, for Work specified in the individual Sections.

8. Specifications and Addenda:
   a. Record the following:
      - Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
      - Changes made by Addenda, Change Order, RFI's, or Field Order, and clarifications and interpretations made by Letter of Instruction. All changes made shall be shown on the As-Built.
9. Specifications shall be prepared to include only systems, items and materials that are in the scope of work for this project. Review and coordinate each specification section so there will be no contradicting information of specified items or materials. No work shall be called out in a manner which is not contractually enforceable.
10. A brief description shall be added to the front sheet outlining the scope of work.
11. Include all applicable codes, seismic codes and Cal-Green notes.
12. Include grid lines, north arrow and key map.

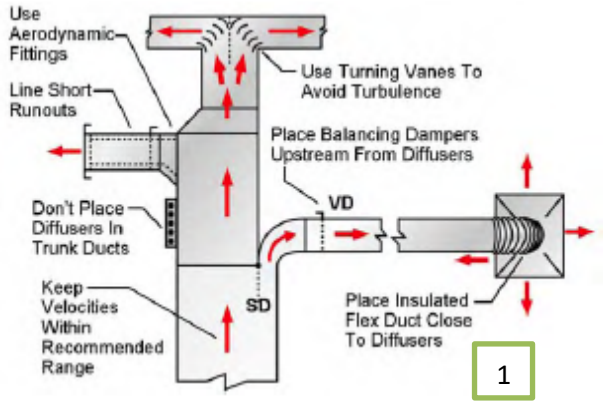
B. DESIGN CRITERIA

This section applies to the general mechanical requirements for all Division 23 work.
This section is intended to assist the Mechanical Engineer and other design team members during the design process by answering questions about how the University builds, operates, and maintains mechanical systems in buildings. If there are questions about this information or proposals of alternate solutions, discuss them with the Project Manager and Engineering Services.

1. Design conditions:
   a. UCLA is located in California Climate Zone 9, 34.1 Lat., Elev. 430 Ft.
   b. UCLA (below) or ASHRAE (design at 0.5%) for offices, classrooms, residential and other similar buildings, whichever is the worst case:
      - Summer: 92°F dry bulb, 69°F wet bulb, 20°F outdoor daily range
      - Winter: 39°F dry bulb, 1509 heating degree days
      - Cooling Coil row/depth and fins per inch sizing (FPI not to exceed 12): 99°F dry bulb, 71°F wet bulb. See 2b below.

2. For laboratories, healthcare and other similar critical buildings.
   a. Summer: 92°F dry bulb, 69°F wet bulb, 20°F outdoor daily range
   b. Winter: 38°F dry bulb
   c. Cooling Coil row/depth (coil sizing) and fins per inch sizing (FPI not to exceed 14): 99°F dry bulb, 71°F wet bulb.
   d. For 100% outside air handling unit and chilled beam system, size the system based on 99°F dry bulb, 72°F wet bulb.
   e. For cooling tower performance, use ambient wet bulb of 74°F.
   f. Campus chilled water supply of 46°F. During high demand days, chilled water supply may reach 50°F.
   g. Design chilled water system with delta T of 16°F.
   h. Use Enthalpy sensors in conjunction with economizers/OSA.
3. Air side: Sizing: grilles, louver, ducts, flex and door gap

Item	Criteria	Notes
Return Air Grille(plenum) 	350 FPM max or full neck size, whichever has the lowest FPM value.	Provide a 3 foot section of flex, sized at 350 ft/min(or 500 CFM max) and connected to the return grille as a means for sound attenuation in sound sensitive offices or rooms. Use rigid elbow.
Outside Air Louver	500 FPM max	Weather/rain type
Diffuser(neck) or Supply Grille(plenum)	500 FPM max	
Door Louver	200 FPM max	
Exhaust Louver (neck or plenum)	500 FPM max	
Transfer Air Duct/Sound Boot	350 FPM max	With acoustic liner. Use ½ inch minimum wire screen mesh at duct terminations.
High Pressure Duct	2200 FPM max	Supply Air only.
Medium Pressure Duct	1600 FPM max or 0.08 friction/100 feet	Use the more stringent of the two. Supply Air only.
Low Pressure Duct	500 FPM max or 0.05 friction/100 feet	Use the more stringent of the two. Supply Air only.
Door under-cut gap	¾” max (80 cfm), ½” max (60 cfm)	Where permitted by CMC and air transfer allowed (typically restrooms and janitors closets).
Flex Connection	Equal to Grille/Diffuser neck size	5 feet max length of flex.
VAV/CAV inlet length	3-10 feet max Straight duct length	Duct diameter equal to inlet size only for inlet duct. Transition

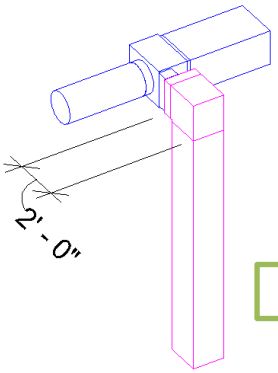
<table>
<tr><td></td><td></td><td>as required prior to duct inlet.</td></tr>
<tr><td>Run-out duct connection to plenum OR main duct.</td><td>One (1) duct diameter between taps</td><td>When connecting to a plenum section or main duct. Connections shall have a staggered tap arrangement.</td></tr>
<tr><td> 

1</td><td colspan="2">1. When connecting a tap, the tap shall be one size smaller as shown in the current SMACNA Duct Construction manual.

2. Where air must split in direction, the major air flow shall be the straight pass through section and the minor air flow shall be the tap/split or the section where change in direction occurs.

3. Balance dampers shall be as far from the diffuser/grille as possible.

4. Duct Risers shall have the same characteristics as shown in the diagram. Plenums not allow on risers to transition, use elbows or “T” fitting as required.

5. Flex connection shall have a ridgid support to prevent the flex from collapsing. Ref. 1</td></tr>
<tr><td> 

2</td><td colspan="2">Typical equipment: Example, VAV: the service clearance shall extend from the service panel horizontally per applicable code (in this case 120 volts is shown as 2 feet) followed by a clear distance vertically down and free from fixed obstacles such as desks and shelving or filing cabinets. 2</td></tr>
</table>

4. Hydronic (Heating/Cooling) and Refrigeration:

Item	**Criteria**	**Notes**
Piping	Friction Loss: 3 ft. WC. per 100 ft.	• Closed Loop systems. • Mechanical joints not permitted.
Valve pressure loss (PIC)	5 ft. max.	Closed Loop
HHW Coils and piping	¾ inch min. diameter.	Closed Loop. Flex connections rated at 200 Deg. F service use minimum
Type ACR pipe or refrigeration grade soft copper		**Refrigeration/Air Conditioning:** • **Provide** insulation and UV protection as required. • Piping shall be installed by a certified Refrigeration Contractor. Contractor to **provide**: • Shop drawings. • RS/RL pipe sizing calculations and verified by the refrigeration unit manufacturer. • Submit to University representative for review and approval prior to installation.
CHW Coils and piping	¾ inch min. diameter.	Closed Loop systems shall have no less than ¾ inch pipe, including run outs.
Steam flex connector, valves and steam above/underground piping	Rated for 490°F service use	Campus high pressure steam is superheated at 400°F with spikes up to 490°F at 125 psig. Valves shall be class 300.
GASKET.		VITON, PTFE gasket or equal.

5. Consult with UCLA Campus Engineering for off-campus locations.
6. Special Rooms:
   a. Provide air conditioning for electric elevator machine rooms and rooms with heat producing equipment such as transformers to maintain 85°F maximum or lower as required by the elevator manufacturer.

b. Provide mechanical exhaust for electrical and mechanical rooms to maintain required environmental conditions. When exhaust is used, outside air shall be filtered. Provide a dedicated CHW cooling unit to maintain 85°F maximum when heat load calculations required mechanical cooling.

c. Where cooling is required and approved up to 3-ton systems, rooms. can be provided with hydronic FCUs connected to building chilled water system. Up to 3-ton, specified high-wall mounted ductless FCU Multiaqua Model MHWW series or equal when outside air is not required or other means of outside air has been provided; up to 5-ton, Multiaqua CFFWA series or equal. Wired only thermostats shall be used. Room temperatures shall be monitored by the BAS
d. Where back-up unit is required. Provide wired thermostats when using FCU.
e. In laboratories, supply and exhaust fans should be designed for operation 24 hours per day, 365 days per year.

e1. Where cooling only is required, room temperature and alarms shall be monitored by campus BAS. Split DX systems or VRF systems shall not be considered unless preapproved by the university.

f. Provide 24-hour cooling in Data, Electrical, Telephone and Fiber Optic rooms. Verify requirements with UCLA Information Technology Services. Standalone equipment utilizing Campus produced chilled water shall be used for both primary and redundant back-up cooling. Equipment shall be sized to accommodate a future load increase of 50%.

7. Operable Windows: Use of operable windows in appropriate spaces is encouraged by the campus, particularly in offices, small classrooms and conference rooms, but not in laboratories where pressure control or isolation is required. Where operable windows are proposed, the HVAC system should be designed to accommodate them. At minimum associated zone HVAC shall be disabled. Local controls shall be suitable to allow the occupant control the temperature within the campus standard temperature range without adversely affecting other spaces. VAV reheat with individual zoning may also be acceptable if adequate local controls are provided. The options should be discussed and coordinated with campus staff during preliminary design.
8. Relief Air and Make-up Air Provisions: Where mechanical systems are required to operate in the event of emergency, design of mechanical systems shall include provisions to relief pressurized rooms and/or supply make-up air to exhausted rooms. In lieu of mechanical systems, natural ventilation shall be used for relief and/or make-up air provided it is approved by Fire Marshal.
9. Laboratory Equipment Cooling System: Use of once-through city water for laboratory cooling is prohibited. Laboratory systems where equipment or experiment cooling may be required shall include piped chilled water from an isolated plate-frame heat exchanger for use by the researchers. The design of laboratory cooling water systems requires close attention to the types of devices which the researchers will use. Chemical treatment, cleanliness and pressure control may be critical. Appropriate provisions for system flushing must be included, including bypasses at the end of dead legs (including connection points when not in use). The designer shall obtain detailed requirements from the end users for supply and return pressures, flow rates, temperature range, and filtration and shall consult with the campus engineering staff regarding proposed system designs. A typical user requirement is filtered water to below 25 microns particulate size with pH and conductivity equal to tap water.

10. Equipment Access: All equipment shall be accessible for maintenance. Equipment installed above the ceiling (such as fans, fan coil units, filters, etc.) shall be provided with sized access panels or hatches to accommodate the removal or service of the largest component. Piping, ductwork and conduits shall not interfere with access. Suitable service platforms or catwalks shall be provided or permanent step ladders shall be used for on-going preventive maintenance and repair service.

11. The access panel shall be sized for the removal of the largest serviceable component with a clear service area from the unit to component and extending down to the floor (desks, shelves, appliances are considered obstacles to servicing equipment above).
12. Machinery Rooms: In addition to building codes, follow ASHRAE Standard 15-2019 “Safety Code for Mechanical Refrigeration” for design of mechanical machinery rooms OR where rooms maybe occupied by service support personal, where refrigeration equipment are to be installed. In case of conflict between codes and ASHRAE Standards, the most stringent shall be used. (Coordinate with Facilities or Building Maintenance when applicable.)
13. Pressure Vessels: All pressure vessels shall be ASME constructed and stamped.
14. Refrigerants: Specify ozone friendly refrigerant similar to R410A. Use of HCFC R-22 refrigerant is prohibited.
15. Motors: Use high efficiency type motors for fans, pumps, compressors, etc.: General Electrical "Energy Saver", Westinghouse "TEC II", U.S. Motors "XB", Baldor "Super E" or equal. For motors used in conjunction with Variable Frequency Drives, provide motors compatible with drive unit. Additionally, any motor controlled by a variable frequency drive shall incorporate a design to prevent arcing through the motor bearings: Insulated bearings grounded motor shafts or add-on devices such as those manufactured by Shaft Grounding Systems or equal (no known equal). AHU and pump motors serving research, health care facilities or any campus building requiring 24/7 operations are to be provided with VFD’s with by-pass. Provide soft-start for motors 60 HP and larger.
16. Manufacturers –Provide variable frequency drive (VFD) manufactured by the following: ABB or equal

C. DRAWINGS, ENERGY MODELING AND CALCULATIONS

1. Design Statement
   a. During the various design phases, the Engineer will develop 3 options and schemes for selection of the appropriate HVAC system.
   b. The new HVAC system shall have the following characteristics:
      - Energy Efficiency
      - Flexibility for future changes.
      - Durability; ease of maintenance.
      - Reliability.
      - Redundancy (where required and cost effective, consult with UCLA Engineering Services).
      - Future expansion (where required and cost effective, consult with UCLA Engineering Services)
      - Life cycle analysis.

c. Design, layout and installation of equipment shall be in easily accessible locations, and will allow for routine preventive maintenance and service for University personnel and outside contractors.
d. Trace Load 700 (HVAC Heating/Cooling Loads) or equivalent and Energy Pro (Title 24 Compliance only) or a California approved software package shall be used for calculations and compliance.

2. Design Phases: Each project shall be organized to follow a sequential design submission schedule that will include the following drawing sets.
3. Furnish Energy Modeling compliance documentation and forms in accordance with Title 24 California Energy Code Requirements, one model for each building within a complex (EnergyPro or equal compliant model output pre-approved by Campus Building Official).
4. Energy modeling software used for LEED certification shall comply with ASHRAE 90.1G requirements for Energy Simulations, with results reported via current edition USGBC Online Forms (IESVE, eQuest, or equal California compliant program that will meet LEED standards). Confirm with the appropriate agency for compliance applicability.
5. Energy Modeling used to demonstrate compliance with the Savings By Design program may be output from Title 24 compliance models (EnergyPro). Any other output proposed for use from software used for LEED or other Energy Models must be transposed into EnergyPro or preapproved by the Savings By Design Representative.
6. Energy Models used to demonstrate compliance with UC Energy Benchmarks shall be developed using additional runs on the same models developed for LEED and Title 24 compliance, or may be developed on other similar software pre-approved by Campus Building Official.
7. Energy Modeling services for the project shall include as many models as necessary to provide each required output for each building in a way that will correspond to current or updated design features at each point and optimally express project performance within each context (highest percentage beyond Title 24 standard, or ASHRAE 90.1 baseline, or optimal performance relative to the UC Energy Benchmarks). Submit fire and life safety analysis by Code Consultant as required by Campus Fire Marshal. When smoke control is required, report shall include calculations and/or simulations showing various fire scenarios and associated supply and exhaust air flows in lobbies, corridors, stairwells, etc. Analysis shall be submitted and approved by Campus Fire Marshal prior to the design of mechanical systems or issuing of bid documents, whichever occurs first. Mechanical Engineers shall design the smoke control systems based on this report. Any changes to smoke control systems that are not in accordance with the approved report shall be verified by calculations by the same Code Consultant. Report shall be revised accordingly and resubmitted for record.
8. Separate ductwork and piping floor plans in 1/8 scale (minimum) drawings. Ductwork floor plans shall show all supply, return, exhaust and transfer air devices, all dampers (manual balancing, motorized, fire and smoke) duct smoke detectors, terminal air units, fan coil units, and all access panels. Duct sizes and CFM shall be indicated for new and existing. All equipment shall be uniquely tagged, coordinated with as-builts and Facilities DDC shop for tag identifiers.
9. Piping floor plans shall still show ductwork in gray tone (shaded similar to background) for reference and coordination.
10. In small projects, where the number of terminal air units and/or FCUs is less than 10, ductwork and piping plans may be combined in same drawing only if provided it is in 1/4 scale (minimum). Pipe sizes shall also be indicated on floor plans. Fonts shall be 1/8” on full scale drawings.

D. The Central Power Plant (CPP)
Mechanical utilities from the CPP include steam, condensate return, central cooling water and compressed air. Mechanical utilities from the CPP include central cooling water. Due to the capacity and hydraulics limitations of these systems, verify the addition of new loads onto these systems with UCLA Engineering Services. Include an evaluation for building system renovation projects which describes the condition of the building systems, variances from present codes, and identifies spare system capacity or system deficiencies and opportunities for improving energy efficiency. The design team's mechanical, electrical, civil, structural, and architectural disciplines shall participate jointly in this evaluation. The mechanical infrastructure shall consist of the mechanical rooms, penthouses, shafts and plenum areas. Extra attention shall be given to the plenum areas above the corridor ceiling, as they often become the critical space for mechanical and electrical distribution.

Required coordination with Capital Programs Engineering Services:
- Feasibility Report
- Connection to existing utility distribution systems, including capacity and location
- Temporary construction water and sewer point of service
- Load calculations for campus utilities
- Design Guide General Requirements
- Special systems design (research and diagnostic equipment, and other equipment
- Control systems and indoor environmental monitoring,
- Special loads
- Code requirements and impact on criteria
- Air quality design criteria, i.e. ASHRAE 62, and Title 24 current editions
- Fire and life safety
- Energy efficiency and cost
- Sustainability
- Serviceability
- RFI's and Submittals, including TAB reports for review

HISTORIC PRESERVATION
Notify UCLA immediately upon discovery of any historical or archeological findings.

E. **HVAC (Basis of Design), Submit:**
1. EXECUTIVE SUMMARY
2. INTRODUCTION
3. BUILDING CODES and UCLA MEP CAMPUS STANDARDS
4. MECHANICAL (HVAC) SYSTEMS
    - Discussion of existing system
    - Design criteria
    - Outdoor climate conditions
    - Indoor design temperature
    - Internal heat gains
    - Ventilation requirements
    - Exhaust requirements
    - Building hours of operation
    - Noise criteria
    - Air quality and filtration and as it relates to infectious diseases, Including Virus mitigation strategies.

- Design professional shall coordinate with UCLA Project manager and Building Manager for Virus mitigation requirements. This shall include equipment and Sequence of Operation strategies.
- Energy conservation measures
- Mechanical rooms size and temperature control Proposed HVAC systems
- Alternative 1:
- Alternative 2:
- Electrical rooms
- Elevator machine room
- System sizing criteria
- Duct velocities
- Ductwork
- Controls
- Energy measurement instrumentation
- Sustainable / LEED design strategy
- System start-up, testing, adjusting, and balancing
- Systems commissioning
- Electrical systems
- Building service
- Existing normal power distribution
- Emergency power
- Feeders and distribution equipment
- Branch circuit
- Lighting.
- Fire alarm
- Electrical systems
- Plumbing
- Domestic water
- Storm drain
- Sanitary drain
- Natural gas system
- Plumbing fixtures
- BOD Manufacturers
- Piping Material
- Water Distribution
- Fire Protection Systems
- Additional Code Requirements
- Fire Protection recommendation for connection to existing utility distribution systems, including capacity and location, Temporary construction water and sewer point of service, Distribution concepts including piping and ductwork, Load calculations for campus utilities, Noise criteria levels for all spaces

5. HVAC systems and equipment for each building.
6. Envelope and glazing properties identifying further energy use reductions necessary to achieve the mandated energy consumption targets.
7. Mechanical sequences of operation and the operational parameters represented by the energy model and coordinated with Facilities Management for Sequence of Operations.
8. Summary of the life cycle cost analysis with specific recommendations.
9. **Review and apply revised codes that take effect on January 1, 2023.**
   Best Practice Guide:
   Energy Savings with Demand Based Control
   i. Introduction

ii. Drivers of Laboratory Airflow
iii. Reduce Fume Hood Flows
iv. Reduce Thermal Flow Drivers
v. Vary and Reduce Average ACH using DBC
vi. Benefits of Differential Measurement w/ Multiplexed Sensing
vii. Sensed Threshold Levels
viii. Application Considerations
ix. Research Study & Results
x. Energy Analysis

F. **Calculations and Reports (100%SD Level):**
Submit updated BOD report. Coordinate with the Architect and equipment specialists to accommodate equipment, specified for the project. Present all UCLA-approved deviations from HVAC design criteria.
Calculations:
Submit:

1. Heating and cooling load calculations:
   a. Ensure compliance with UCLA HVAC design requirements. These calculations shall be accompanied with the architectural drawings correlating each HVAC zone boundary and the floor area include calculations for:
      - Furnish building block heating and cooling loads:
      - Psychometric chart for each air-handling unit showing cooling and heating coil condition and computation of humidification loads Coil entering and leaving conditions and fan-motor heat gains for supply and return air fans.
      - Room-by-room air balance sheet for each air-handling unit showing supply, return, exhaust, make-up, and transfer air quantities with the required air balance, that is, positive, negative, or zero with respect to adjoining spaces.
      - Indoor and outdoor design temperatures.
      - Shaft locations with sizes and duct/pipe riser sizes

   b. Excel spreadsheet for each air-handling system. Show the details of supply, return, exhaust, make-up, and relief air, for each room. In addition, for each room show area, height, volume, value of one air change per hour, actual calculated air changes per hour, required minimum air changes per hour and a spreadsheet with all heat producing equipment for kitchens.
2. During Demolition phase: Take TAB pre-reads and record the data. Submit for review.

G. **Calculations and Reports (100%DD Level):**
Submit updated BOD report. Coordinate with the Architect and equipment specialists to accommodate equipment specified for the project. Present all UCLA-approved deviations from HVAC design criteria.
Calculations:
Submit:
1. Final version of the room-by-room heating and cooling load calculations:
   a. Ensure compliance with UCLA HVAC design requirements. These calculations shall be accompanied with the architectural drawings correlating each HVAC zone boundary and the floor area, and a room schedule correlating architectural room numbers and abbreviated/coded room numbers used with computer input data sheets. Use all U-factors for building elements based on the actual building construction and

published window data. The accuracy and the level of detail of the calculations shall be consistent with the development of the architectural drawings and include calculations for:

- Peak zone-by-zone heating and cooling loads
- Building block heating and cooling loads
- Psychometric chart for each air-handling unit showing cooling and heating coil condition and computation of humidification/dehumidification loads
- Coil entering and leaving conditions and fan-motor heat gains for supply and return air fans
- Room-by-room air balance sheet for each air-handling unit showing supply, return, exhaust, make-up, and transfer air quantities with the required air balance, that is, positive, negative, or zero with respect to adjoining spaces
- Indoor and outdoor design temperatures

b. Excel spreadsheet for each air-handling system. Show the details of supply, return, exhaust, make-up, and relief air, for each room. In addition, for each room show area, height, volume, value of one air change per hour, actual calculated air changes per hour, required minimum air changes per hour and a spreadsheet with all heat producing equipment for kitchens.
c. ASHRAE 15 and CMC 1104.2 refrigerant concentration limits, to include VRF/split systems and Central Air systems
d. Whenever the design includes connecting to existing equipment, contractor to provide pre-flow readings for water and air and issue a report. Contractor shall list associated existing equipment in the equipment schedule for “Reference Only”
e. During Demolition phase: Take TAB pre-reads and record the data. Submit for review.

H. **Calculations and Reports (50 and 100%CD Level):**

1. Submit updated narrative BOD report including an updated energy modeling report and any comments from previous reviews by UCLA. State that the energy model represents the operational parameters of all designed systems and uses actual equipment performance curves from the design selections (mechanical, plumbing, and lighting).
2. Discuss any adjustments and their effects from the previous submittal.
3. Submit complete and final energy and engineering calculations of all systems and provide the REVIT model for review. In addition to room by room heating and cooling calculations. Submit each type of calculation, tabulated and indexed, a separate package to include the following:
   a. Final selection of all pumps with the pump head calculations based on the actual piping layout and takeoffs, and pressure drop through the equipment selected for the systems.
   b. Final selection of all fans with the fan static pressure calculations based on the actual duct layouts and takeoffs, and static pressure drop through the equipment for the systems. (Detailed calculations are required even if variable speed drives are used.)
   c. Sizing and selection of all expansion tanks based on the actual piping layout and volume computation.
   d. Sizing and selection of all steam to hot water convertors and heat exchangers based on the flow requirement of each terminal unit, i.e., duct-mounted reheat coil, box (air terminal unit). Mounted reheat coil, unit heaters, convectors, finned tube radiators, and radiant ceiling panels.

e. Acoustic analysis of all systems and steps taken to ensure compliance with the specified noise levels for projects that are noise sensitive or required by UCLA.
f. Complete selection data including catalog cuts and calculations for all HVAC equipment and drawings, showing all equipment schedules.
g. Complete coordination with equipment by providing utility connections, interface between the local controls, trend log and recording requirements, and local and remote alarms (verify with UCLA for required local and remote alarm requirements).
h. Humidity control calculations and assumptions.
i. Show on plans all mechanical/plumbing Shaft locations with sizes and duct/pipe risers
j. ASHRAE 15 and CMC 1104.2 refrigerant concentration limits, to include VRF/split systems and Central Air systems

4. Air Balance Schedule, indicating CFM of outside air, supply air, return air and exhaust air for each air system. Each system must be reasonably balanced.
5. 1/4 inch scale or larger Equipment Room Plan and sections showing each major piece of mechanical equipment, such as water chillers, cooling towers, air conditioning units, fans and air handling units.
6. Pipe riser diagrams of hydronic piping systems where the number of terminal air units and FCUs are more than 10. Indicate pipe sizes, flow rates, and valves (shutoff, check balancing, control, relief, air vent, etc.).
7. Control diagrams including approved sequences of operation, and I/O point lists. Indicate point list to be shown on graphics.
8. Cooling load calculations shall include tabulation by the designer of the equipment loads within each room.
9. Use ASHRAE Fundamentals, latest edition, for cooling and heating load calculations. Submit two copies for university review. The procedures guide requires that the designer furnish comparative analysis of alternative systems.
10. The designer shall use separate “ME” sheets for control diagrams. Show on the plans a complete schematic control diagram, including items furnished, installed, wired or piped by the equipment manufacturer. Each schematic diagram shall include a sequence of operations per university standard formatting.
11. Indicate each local DDC control panel on the floor plans, Coordinate with Facilities Management for the nearest control panel for remodels that involve controls upgrade.
12. The Mechanical designer shall verify that Duct Smoke Detectors are clearly indicated on floor plan and fire alarm system drawings, and that control conduit is shown on plans (probably on electrical plans).
13. All equipment schedules must be shown on the plans, not on the specifications. The plans become the campus’ permanent record, and are referred to for maintenance and operations purposes. The specification book is not a readily accessible record.
14. Specification title and numbering shall be based on MasterFormat (version as approved by University’s Representative) and content shall be in CSI 3-part format (Part 1-General, Part 2-Product, and Part 3-Execution).
15. Mechanical specification sections shall have separate sections, independent of the plumbing specification sections.
16. Mechanical details to be included in the plans (when applicable):

- Equipment, duct and piping supports including seismic bracing installed inside and outside the building. Include wind load for exterior installation.
- Vibration isolation and seismic restraints
- Pump piping detail
- Cooling tower piping detail

- Heat exchangers, boilers, and coils piping details
- Manual air vent and automatic air vent details
- Open type expansion tank
- Bladder type expansion tanks
- Chilled water metering, air separator, etc.
- Equipment drains. Provide hose end connections to all drain valves. Drain valves above finished ceiling shall be provided with chained cap.
- Boiler piping detail
- Steam condensate return pump (duplex type) piping details
- Steam coils
- Steam humidifiers
- Steam pressure reducing station
- Steam main end of line drips
- Steam main dirt leg
- Steam converters
- Unit heaters
- Steam condensate metering
- Flash tank
- Steam safety vent elbow drip pan
- Cooling coil pan condensate drain piping
- Concealed or exposed duct and pipe penetrations through walls, floors and roof. Coordinate with the architect's drawing.
- Injection Fittings (including injector and tubing) for chemical treatment of water piping system.
- Underground fuel storage tank
- Fire/smoke dampers (indicate UL listed and FM approved)
- Manual volume damper detail for rectangular and round duct. Damper detail shall indicate all galvanized hardware except use brass trunions and bronze oilite bearing
- Branch duct take-off
- Supply and return air registers/grilles
- Duct elbows
- Air foil turning vanes – single vanes with trailing edge is acceptable. The length of trailing edge shall be 3 times the vane spacing.
- Transfer air duct
- Flexible connectors
- Duct access door
- Damper quadrant on "hat" section for insulated ductwork
- Constant and variable air volume terminal
- Fume hood duct connection (bellmouth connection)
- Commercial kitchen exhaust
- Equipment housekeeping pad
- Pipe/duct through roof detail
- All scheduled items have an installation detail with embedment and fastener type

17. Nomenclatures:

AC	Air Conditioning Unit
AD	Access Door
AHU	Air Handling Unit
AI	Analog Input
AO	Analog Output
AP	Access Panel
APD	Air Pressure Drop
BDD	Backdraft Damper
BMS	Building Management System
BOD	Bottom of Duct/Basis of Design
BTU	British Thermal Unit

BTUH	BTU per Hour
CAV	Constant Air Volume, Terminal Unit
CD	Condensate Drain
CDP	Condensate Drain Pump
CC	Cooling Coil
CFM	Cubic Feet per Minute
CH	Chiller or Chilled
CHB	Chilled Beam
CHW	Chilled Water
CHWP	Chilled Water Pump
CHWR	Chilled Water Return
CHWS	Chilled Water Supply
CLG	Cooling
CO	Carbon Monoxide
CO2	Carbon Dioxide
CR	Condensate Return, Steam, Gravity
CRP	Condensate Return Pump
CT	Cooling Tower
CTP	Cooling Tower Pump
CU	Condensing Unit
CW	Condenser Water
CWP	Condenser Water Pump
CWR	Condenser Water Return
CWS	Condenser Water Supply
DB	Dry Bulb Temperature
DDC	Direct Digital Control
DI	Digital Input
DO	Digital Output
DP	Differential Pressure
DT	Dew point Temperature
(E)	Existing
EA	Exhaust Air
EAT	Entering Air Temperature
EF	Exhaust Fan
ESP	External Static Pressure
ET	Expansion Tank
EWT	Entering Water Temperature
FA	Free Area
FCU	Fan Coil Unit
FD	Fire Damper
FEF	Fume Hood Exhaust Fan
FF	Final Filter
FH	Fume Hood
FLA	Full Load Amp
FPM	Feet per Minute
FS	Flow Switch
FSD	Fire/Smoke Damper
GA	Gauge
GEF	Garage Exhaust Fan
GPH	Gallon per Hour
GPM	Gallon per Minute
HC	Heating Coil
HHW	Heating Hot Water
HHWP	Heating Hot Water Pump
HHWR	Heating Hot Water Return
HHWS	Heating Hot Water Supply
HP	Heat Pump or Horsepower
HPS	High Pressure Steam
HRU	Heat Recovery Unit
HTG	Heating
HX	Heat Exchanger
HZ	Hertz
KEF	Kitchen Hood Exhaust Fan
(L)	Lined
LAT	Leaving Air Temperature
LEF	Laboratory Exhaust Fan
LPS	Low Pressure Steam
LVG	Leaving
LWT	Leaving Water Temperature
MAX	Maximum
MCA	Minimum Circuit Ampacity
MIN	Minimum
MUA	Make-up Air
(N)	New
NC	Normally Closed
NO	Normally Open
OA	Outside Air
OAF	Outside Air Fan
OC	On Center
OV	Outlet Velocity
PCF	Pounds per Cubic Foot
PCHP	Process Chilled Water Pump
PCHR	Process Chilled Water Return
PCHS	Process Chilled Water Supply
PCHW	Process Chilled Water
PD	Pressure Drop
PF	Pre-Filter
PH	Phase
POC	Point of Connection
PRV	Pressure Reducing Valve
(R)	Relocated
RA	Return Air
RF	Return Fan
RH	Relative Humidity
RLF	Relief
RTU	Rooftop Unit
S	Sensor
SA	Supply Air
SD	Smoke Detector, Damper
SF	Supply Fan

SP Static Pressure
SPF Stairwell Pressurization Fan
SR Supply Register
SW Switch
T Temperature, Thermostat
TCHW Tempered Chilled Water
TCHP Tempered Chilled Water Pump
TCHR Tempered Chilled Water Return
TCHS Tempered Chilled Water Supply
TEF Toilet Exhaust Fan
THHW Tempered Heating Hot Water
THWP Tempered Heating Hot Water Pump
THWR Tempered Heating Hot Water Return
THWS Tempered Heating Hot Water Supply
TSP Total Static Pressure
UC Door Undercut
UH Unit Heater
UMP Utility Metering Panel
VAV Variable Air Volume, Terminal Unit
VD Volume Damper, Manual
VFD Variable Frequency Drive
WB Wet Bulb Temperature
WC Water Column
WSHP Water Source Heat Pump
WPD Water Pressure Drop

GREEN BUILDING POLICY COMPLIANCE

A. All projects must comply with the UCLA Campus Green Building Baseline Standard and must meet the UC-equivalent of the USGBC “LEED Silver” with a target of Gold. A copy of the latest baseline standard shall be obtained by the designer. Some of the baseline requirements that have particular MEP impact include:
   1. Fundamental Building Systems Commissioning.
   2. Minimum Energy Performance must outperform California’s Title 24 Energy usage standards by at least 20 %(Mechanical and Lighting systems combined). Demonstration of this will be required in the energy compliance certification on the plans. (EA Credit1).
   3. Minimum Indoor Air Quality Performance (EQ Prerequisite 1).
   4. Construction Indoor Air Quality Management Plan (EQ Credit 3.1).
   5. Thermal Comfort – Compliance with ASHRAE 55-2020 required for all mechanically ventilated buildings (EQ Credit 7.1).
B. In addition to the baseline requirements, each project must consider the additional USGBC LEED criteria that shall be feasible to attain a minimum LEED “certified” rating for the project.

230900 INSTRUMENTATION AND CONTROL FOR HVAC

A. Preferred vendors: Desigo Tridium Campus Supervisor, running Niagara current campus server campus firmware. Where projects without Building Supervisor, add a Building Supervisor JACE and shall be consistent with the selected building control vendor to be installed, running the campus approved Linux OS. Control system shall integrate to SKYSPARK Analytics seamlessly and the Contractor shall be responsible for all control components including all required control points and programming required to integrate to SKYSPARK. The contractor shall be responsible for programming a minimum 40 campus approved “Rule/Sparks”. The campus has standardized equipment suppliers for Direct Digital Control and Energy Management systems. Selection of control equipment shall be approved by UCLA Capital Programs Engineering and Facilities Management before specifying. Coordinate with Facilities Management for Control Details, Specifications and Sequence of Operation guidelines.
B. The campus prefers all electronic control systems, including electric actuators for valves and dampers connected to a server-based Facility Automation System using DDC technology.

The designer should recommend the appropriate choice for the specific project in consultation with campus staff.

C. DDC systems for Research, Health Care and other campus buildings requiring 24/7 operations are to be connected to the Emergency Power and provided with battery back-up.
D. Low voltage control wiring and conduit shall be shown under the Mechanical Section. Line voltage control wiring and conduit shall be shown under the Electrical Section. Conduit runs must be indicated on electrical drawings. Do not assign work to subcontractors by the use of phrases such as “by electrical” or “by mechanical.”
E. For High Rise and H Occupancies, provide a Fireman's Panel (painted red) as approved by University Fire Marshall adjacent to motor control center (MCC) with hand/off/automatic (HOA) switch for each air system with duct smoke detectors (DSD). Wire HOA switch in Fireman's Panel so that "H" position bypasses the DSD and the "A" position is wired through the DSD. Provide appropriate labeling.
F. Smoke control/evacuation: Under normal operation, the DDC system controls all ventilation fan and damper operations. When a fire alarm is initiated, the Fire Alarm Control Panel (FACP) shall override the DDC system and assume direct control of all fans and dampers that are part of the smoke control system. This shall be done through the operation of appropriate relays external to both the DDC and FACP. The FACP shall not use the DDC system for smoke control or evacuation. Fire Smoke Dampers shall be monitored by the DDC system
G. Each humidifier installed inside an air duct or plenum shall be equipped with a high limit humidistat.
H. Variable frequency drives shall be ABB or equal for HVAC pumps and fan systems are to be controlled by the building DDC system. HVAC pumps and fans shall be start/stopped by the DDC System. Status, through current sensing relay mounted in the starter bucket, shall be monitored through the DDC system. Pumps shall be lead/lag duty. Water Differential Pressure Transmitter located at the end of the piping shall control, through the DDC system, the VFD on the pumps to maintain system pressure.
I. Chilled water supply and return temperatures and chilled water flow shall be monitored through the Campus Utility Monitoring Panel (UMP). The UMP shall calculate BTU consumption. The DDC System shall calculate BTU consumption.
J. Provide meters for all building utilities (steam/boiler, electricity, and chilled water). Metering specifications for chilled water and steam to be provided by UCLA. Domestic water meter requirements are described in section for building interior plumbing systems and connect all meters to the UMP including but not limited to the electrical, thermal (chilled water, hot water heating and/or steam), domestic water and natural gas (if applicable).
K. Occupancy Sensor used for HVAC integration shall be hard wired.
L. Coordinate with Facilities Management for any Utility Metering specifications and Network Architecture.
M. All lighting control sensors shall have a minimum of two isolated relay contacts for hardware integration

230593 TESTING, ADJUSTING AND BALANCING

A. Perform testing, adjusting and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed. The contractor shall field report approved for start of system commissioning followed by a Final TAB report. HVAC Systems Testing and balancing shall be in accordance with the following:
   1. Associated Air Balance Council (AABC) “National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning System” latest edition.
   2. ASHRAE HVAC Applications Manual, 2019, Ch. 8 Testing, Adjusting and Balancing.

231113 NATURAL GAS PIPING SYSTEMS

A. A readily accessible gas cock shall be installed at the point of connection to each gas fired piece of equipment, laboratory bench, fume hood and exposed union.
B. Unions shall not be installed in concealed areas such as ceilings, walls or behind access panels.
C. Gas piping shall not be installed below any on-grade interior concrete floor slab; service pipes must rise to be above grade at the perimeter of the building. Island type fixtures will be supplied from overhead if possible, or through piping sleeves below the slab.
D. Piping material shall be Schedule 40 ASTM A-53 steel with screwed malleable fittings 2 inch and smaller for 10 inches of mercury and welded joints 2½ inch and larger and all pipe sizes for medium 3 to 5 psi pressure. Below on grade floor piping shall not be indicated.
E. The use of fossil fuel combustion has limited exceptions per UCOP. Consult with UCLA Capital Programs prior to design documents (not applicable to Acute Care Facilities.)

232113 HYDRONIC AND REFRIGERATION PIPING SYSTEMS

A. GENERAL REQUIREMENTS

1. Campus chilled water supply of 46°F. Design chilled water system with delta T of 16°F. During design months the supply chilled water temperature may reach as high as 50°F. Provisions shall be made to provide the required indoor conditions.
2. The Southern portion of the main campus is served by a central chilled water distribution system supplied by the Central Chiller & Cogeneration plant. This system supplies 46°F chilled water, and a minimum of 16°F temperature drop. This supply temperature shall be used for most air conditioning and laboratory chilled water systems. The appendix contains standard requirements for connection to the central chilled water loop. Systems connected to the central chilled water loop must use two-way valves and variable speed pumping systems to coordinate with the central system. Connections will be “hydraulically coupled” (not decoupled). Provide a normally open bypass control valve piped in parallel with redundant secondary pumps. This valve shall allow Cogen Plant pumps to deliver water under low load conditions without running the secondary building pumps. Insulate buried chilled water supply lines from the point of connection to the building to be served. Provide dielectric flange at the entrance to the building on chilled water supply and return lines.
3. Building chilled water and heating hot water lines shall be metered. When building steam line is provided with meter then heating hot water line shall not be metered. Meters shall be ultrasonic type, Flexim Flexus F721 or equal. Indicate size of meter, maximum and minimum flow, and pressure and temperature sensors on mechanical drawings. Meters shall be sized so minimum flow (or 10% of maximum flow, whichever is lower) is within its range. Meters shall be connected to UMP.
   Meter must be installed 10 diameter lengths upstream and 5 diameter lengths downstream.
   Temperature sensors shall be Minco or equal.
   Energy Calculator will be provided by the University.
4. Provide dielectric flange kits on supply and return lines at the entrance to the building to isolate from buried utility lines. Flange isolation assembly kit shall consist of all components necessary to ensure complete isolation of cathodically protected underground chilled/hot water piping from building piping by means of electronically controlled devices (Impressed current) and pre-insulated piping with foam insulation. If

ductile iron piping is directly buried, it shall be continuously-coated and insulated to reduce the potential for corrosion. Similar cathodic protection techniques shall be applied to water storage tanks, steel tanks and softeners.

5. Use of once-through city water for laboratory cooling is prohibited. Laboratory systems where equipment or experiment cooling may be required shall include piped chilled water from an isolated plate-frame heat exchanger for use by the researchers. Design of laboratory cooling water systems requires close attention to the types of devices which the researchers will use. Chemical treatment, cleanliness and pressure control may be critical. Appropriate provisions for system flushing must be included, including bypasses at the end of dead legs (including connection points when not in use). The designer shall obtain detailed requirements from the end users for supply and return pressures, flow rates, temperature range, and filtration and shall consult with the campus engineering staff regarding proposed system designs. A typical user requirement is filtered water to below 25 microns particulate size with pH and conductivity equal to tap water.
6. Connection to CHS: UCLA personnel shall make the actual connection to any existing piping system in all buildings in Center for Health Sciences and Medical Plaza. Drawings shall show Contractor's point of connection to UCLA furnished outlets.
7. Campus Utility Connections: Engineers/designers shall consider the impact of connections to general campus systems and furnish instructions to maintain service continuity and minimize shutdown duration. In most cases, the actual connection shall be made by campus personnel. Coordinate the responsibility for making the connection with University's Representative.
8. Chilled beam hydronic piping system shall be isolated from campus chilled water loop using plate and frame heat exchanger. Refer to campus standard for operating temperatures (Hot/Cold water systems).
9. Manufacturers –Provide plate and frame manufactured by the following:
   Alfa Laval or equal

10. **Any fastener exposed to weather or in contact or possible contact such as condensate with water shall be stainless steel.**

B. PIPING MATERIALS

1. Copper Pipes and Fittings
   a. Hard drawn copper tube, type K, ASTM B88, permanently color marked with manufacturer's trademark and country of origin. Type "K" shall be marked in green.
   b. Fittings: Up to NPS 2 with system temperature up to 140°F shall be wrought-copper solder-joint fittings, 95-5 tin-antimony, soldered.
   c. Fittings: Up to NPS 2 with system temperature above 140°F and all underground piping, shall be wrought-copper solder-joint fittings, Sil-Fos silver brazed.
      - Cut square, remove burrs and clean outside of pipe and inside of female fittings and to a bright finish with steel wool, wire brush, sandpaper or emery cloth. Apply solder flux with brush to tubing.
      - All soldered or brazed joints shall be made by a brazer currently certified for the size of pipe being brazed or for minimum 1-1/2-inch pipe. Certifying individual or agency shall in turn be certified by AWS.
      - All soldered or brazed joints shall be acceptable only if 100% full joint penetration of the soldering or brazing alloy is achieved.
      - All soldered or brazed joints shall comply with Section IX of ASME Boiler and Pressure Vessel Code.

d. Fittings: NPS 2-1/2 and larger may be roll grooved mechanical-grooved fittings suitable for hydronic condenser water, rated at 300 psi and only used in exposed areas.
e. All copper fittings shall be approved-type, factory made, wrought or cast pressure fittings and have integral formed pipe stops on each connection. Mechanically formed tee fittings utilizing mechanical extracted collars or blazed outlets shall not be used.
f. Brazing cast copper fittings is not permitted under NFPA 13.

2. Steel Pipes and Fittings
   a. Pipes: Standard weight, ASTM A53, type E, carbon steel.
   b. Fittings: Malleable iron fittings (less than 140°F) and cast iron fittings (above 140°F) on screwed joints.
   c. Fittings: Carbon steel weld fittings and weld flange.
   d. Fittings: Wrought cast- and forged-steel flanges and flange fittings.
   e. Fittings: Wrought grooved mechanical-joint fittings and couplings. Use stainless Steel fitting where fitting is exposed to high condensation or humid conditions such as chilled water routed above the ceiling in a corridor.
   f. Fasteners: **Any fastener exposed to weather or in contact or possible contact such as condensate with water shall be stainless steel.**

3. Underground Hydronic Piping: Refer to Site Utilities for hydronic piping below ground.
4. Condensate Drain Piping: Hard drawn, copper type L, ASTM B88. Not permitted for any other use other than for atmospheric pressure condensate piping.
5. Refrigeration: ACR type (soft or hard drawn) pipe and all brazed system with min 15 percent silver floss brazing material.

C. VALVES.
1. Several valve manufacturers carry separate domestic and import lines. The import lines are often of inferior quality. Where a specification refers to such a manufacturer, the specification writer shall verify that the valve model numbers specified are for the domestic made valves and not the import line of the manufacturer.
2. All valves for future connection shall be capped or plugged. Drain outlets shall be piped to drain or plugged. Unplugged open valve ends will eventually leak and cause damage.
3. Ball valves shall be full port with stainless steel ball and stem with screwed connections. Ball valves 2-inches and smaller NIBCO T-585-70-66, Hammond 8303A or equal.
4. Soldered end valves are NOT ACCEPTABLE and shall not be specified except when factory installed as part of the equipment.
5. Pressure independent flow control valves: Danfoss PICV - N AB-QM™ Valves or equal.

D. METER. Thermal energy meter shall be Flexim Flexus F721 or equal; complete with transit-time ultrasonic type flow sensor with transmitter, strap-on or insertion type temperature sensor, remote computer panel in NEMA 4X enclosure; Accuracy +/-1.0% of reading ±1.0 feet/second; Display shall indicate total volume and thermal-energy flow.

E. DIELECTRIC FITTINGS.

1. Dielectric Flange Kit: Flange isolation kit complete with neoprene-faced phenolic full-faced gasket, double phenolic washers, double steel washers, and phenolic sleeves, ANSI rated 150 psi, 100°F maximum temperature. Assembly kit shall be as manufactured by Hoff Company, Inc. (281-997-6482), Pipeline Seal and Insulator, Inc. (713-747-6948), or equal.

2. Dielectric Nipple: Electroplated steel nipple with inert, NSF/FDA listed and noncorrosive, thermoplastic lining; minimum 3-inch long; plain, threaded, or grooved ends; and ASTM F-492, 300-psig minimum working pressure at 225°F. Clear Flow or equal.

F. GASKET.

1. Hot water piping systems shall use Garlock 3200/3400 gasket or equal.

G. INSULATION.

1. Use rigid insulation (calcium silicate for heating hot water and cellular glass for chilled water) for pipes exposed in equipment rooms and other areas subject to physical damage. Fiberglass is acceptable in other locations. Minimum insulation conductivity and thickness shall comply with Title 24 Section 123.

H. IDENTIFICATION.

1. Piping shall be identified using wraparound markers.

I. INSTALLATION

1. Provide air vents at all high points and intermediate high points created by job conditions. For each manual and automatic air vent, provide drain piping to nearest floor drain or floor sink. Provide automatic air vents in machine rooms and other areas where air vents are accessible and can be easily piped to drain. In areas where vents are inaccessible, provide air chambers at high points and run 1/4" copper tube with shut-off valves to an accessible area (preferably in equipment rooms) and identify location and use. In areas where vents are accessible but impractical to pipe to drain (like above T-bar ceilings) provide ball valves with bend tube positioned for easy drain to a mechanics bucket. Coin operated air vents are not acceptable.
2. For water supply and return lines, cooling coil, heat exchanger, etc., use a balancing valve in addition to the shut-off valve. Combination balancing and shut-off valves are not recommended. Where two-way valves are used for coil control, use pressure independent flow control valves.
3. Avoid bull-headed tees in all piping system.
4. As required by Applicable Code Requirements, no piping shall be routed in any electrical room, vault or areas designated for electrical or communication equipment.
5. Specify replaceable bladder type expansion tanks.
6. Provide air and dirt separator on chilled water and heating hot water piping system. Unit shall be of full flow coalescing type combination air and dirt separator with internal elements filling the entire vessel with no space or void, venting chamber and valves, and valve side tap. Internal elements shall be of copper core tube with continuous wound copper medium permanently affixed to the core. Internal elements consisting of plastics or perforated steel plates/tubes or loosely filled steel rings are not acceptable. Unit shall be Spirovent as manufactured by Spirotherm or equal.
7. For roof mounted pumps above, sensitive areas such as labs having electron microscopes, classrooms, etc., use neoprene type flexible connectors. Do not use braided metal type connections. Provide vibration isolators for pipes from rotating equipment (pumps etc.) supported on roof.

8. No pipe shall be encased, embedded or cast into the building's concrete footings, floor slabs, walls or other structure. Taping and/or foam wrapping of pipe and fittings does not constitute a code or University approved method of separation.

J. BOIL OUT AND CLEANING OF PIPING SYSTEMS

1. Perform cleaning and boil-out after completion of piping and pressure testing and before the system is put into operation. All piping system cleaning and water treatment must be coordinated with and witnessed by campus operating staff. It is imperative that before any system is filled with water, the operating staff verify that cleaning has been properly completed and proper chemical treatment is in place and maintained. Operating staff shall be requested to monitor chemical treatment after the system is filled until the project is completed. The contractor shall be responsible for maintaining the chemical treatment until the building is formally turned over to the University. The Inspector shall witness the cleaning procedure.
2. Chilled water systems served by the campus central chilled water system shall be filled only with clean untreated water.
3. Do not circulate cleaning solution through cooling and heating coils or steam traps. Provide temporary bypasses.
4. The entire cleaning procedure shall be performed by a Contractor furnished independent chemical cleaning company approved by the University's Representative.
5. Flush out the entire system for a period of not less than 4 hours to clear it of all loose material. Provide necessary cross-connections to loop system and circulate water for 24 hours. During this period, install 80-mesh screen in strainers and periodically clean. Drain the entire system. Refill system. Meter water when refilling to determine amount of chemical required in next procedure. Add trisodium phosphate (TSP) to achieve a uniform residual concentration of 10ppm. Circulate water for 48 hours. During circulation, periodically clean screens as required. Flush system for approximately 4 hours or until all traces of chemicals are removed. Remove 80-mesh screens.
6. For space heating hot water system, provide injection fitting and required connection piping to a 55-gallon chemical drum. Drum shall have provision for wall straps to safely secure to the wall. A chemical pump, controls and interval timer shall be provided. Coordinate with electrical to provide required power for the pump. Coordinate with the plumbing engineer to provide sink and emergency shower/eyewash in mechanical room where water treatment will be performed. Run ¼" copper tubing from the water piping system to the sink with appropriate labels and service valves for collecting samples.
7. The piping system must be complete, pressure tested and cleaned. If water treatment has to be redone due to Contractor's incomplete work, extra services furnished by UCLA Facilities will be at Contractor's expense.

K. PRESSURE TESTING.

1. All pressure pipe testing shall be done using a Bristol Recording Device. Hydrostatically field test pipe to 150 psig or 1.5 times the design pressures whichever is greater before insulating the field joints.

232213 STEAM AND CONDENSATE HEATING PIPING SYSTEMS

A. GENERAL REQUIREMENTS

1. Building steam line shall be metered. Sensors shall be rated to withstand steam temperatures up to 490°F. Indicate size of meter, maximum and minimum flow, and pressure and temperature sensors on mechanical drawings.

B. PIPING MATERIALS

1. Steam Pipes and Fittings: Steel pipe ASTM A53 type E schedule 40, standard weight, black with butt weld ends; Standard weight carbon steel, butt weld, ASTM A234, Class 300 with butt welded joints per AWS D1.1.
2. Condensate Return Pipes and Fittings: Extra heavy carbon steel pipe, ASTM A53 Grade B, seamless, black with butt weld ends; extra heavy weight carbon steel, butt weld, ASTM A234, Class 300 with butt weld joints per AWS D1.1.
3. Underground Steam and Condensate Return Piping: Refer to Site Utilities for steam and condensate return piping below ground. Note that for a momentary period, steam supply temperatures may reach as high as 490°F. Make provisions to account for such temperatures with expansion and components which may operate at such temperatures.

C. METER.

1. Meter shall be vortex shedding type - Siemens - Sitrans FX300 Vortex Flow Meter or equal. The Energy Calculator shall be a Endress Hauser –RS33; complete with transit-time ultrasonic type flow sensor with transmitter, strap-on or insertion type temperature sensor, remote computer panel in NEMA 4X enclosure; Accuracy +/-1.0% of reading ±1.0 feet/second; Display shall indicate total volume and thermal-energy flow, Min.
2. Steam traps: use

ARMSTRONG 881 1/2" THD 15# (1/4" ORIF) CI IB STEAM TRAP WITH STR w/ BLOWDOWN	2005-3000BD
ARMSTRONG 881 1/2" THD 30# (3/16" ORIF) CI IB STEAM TRAP WITH STR w/ BLOWDOWN	2005-3010BD
ARMSTRONG 881 1/2" THD 200# (7/64" ORIF) CI IB STEAM TRAP WITH STR w/ BLOWDOWN	2005-3040BD
ARMSTRONG 881 3/4" THD 15# (1/4" ORIF) CI IB STEAM TRAP WITH STR w/ BLOWDOWN	2005-3060BD
ARMSTRONG 881 3/4" THD 30# (3/16" ORIF) CI IB CI IB STEAM TRAP WITH STR w/ BLOWDOWN	2005-3070BD
ARMSTRONG 881 3/4" THD 200# (7/64" ORIF) CI IB STEAM TRAP WITH STR w/ BLOWDOWN	2005-3100BD
ARMSTRONG 881 1" THD 200# (7/64" ORIF) CI IB STEAM TRAP WITH STR w/ BLOWDOWN	2005-3160BD

D. GASKET.

1. VITON, PTFE gasket or equal.

E. INSULATION.

1. Use rigid insulation (calcium silicate) for pipes exposed in equipment rooms and other areas subject to physical damage. Minimum insulation conductivity and thickness shall comply with Title 24 Section 123

F. IDENTIFICATION.

1. Piping shall be identified using wraparound markers.

G. DIELECTRIC FITTINGS.

1. Provide dielectric flange kits on supply and return lines at the entrance to the building to isolate from buried utility lines. Flange isolation assembly kit shall consist of all components necessary to ensure complete isolation of cathodically protected underground steam water piping from building piping by means of electronically controlled devices (Impressed current) and pre-insulated piping with foam insulation. If ductile iron piping is directly buried, it shall be continuously-coated and insulated to reduce the potential for corrosion.

H. INSTALLATION.

1. No pipe shall be encased, embedded or cast into the building's concrete footings, floor slabs, walls or other structure. Taping and/or foam wrapping of pipe and fittings does not constitute a code or University approved method of separation.

I. BOIL OUT AND CLEANING OF PIPING SYSTEMS

1. Perform cleaning and boil-out after completion of piping and pressure testing and before the system is put into operation. All piping system cleaning and water treatment must be coordinated with and witnessed by campus operating staff. It is imperative that before any system is filled with water, the operating staff verify that cleaning has been properly completed and proper chemical treatment is in place and maintained. Operating staff shall be requested to monitor chemical treatment after the system is filled until the project is completed and turned over to them. The Inspector shall witness the cleaning procedure.
2. Do not circulate cleaning solution through cooling and heating coils or steam traps. Provide temporary bypasses.
3. New equipment (or otherwise in very good condition) shall not be used for the circulation of chemical cleaning solutions intended to remove built-up scale and corrosion in existing piping systems at any point, before or after system modification.
4. If the existing pump system are already in poor condition and/or would not be appropriate for meeting final operating conditions and are not economical to salvage and thus to be entirely replaced anyway, the Contractor may use the existing pump for the circulation of cleaner/dirty fluid prior to replacement.
5. If the existing pump system is otherwise in good condition and planned to be reused after chemical cleaning operations, then:
6. Include all materials and labor for inspection and cleaning of all wetted parts and replacing of worn items, at a minimum the definite replacement of the seals, after all chemical cleaning and flushing is completed and before system is refilled with final clean fluid.
7. The entire cleaning procedure shall be performed by a Contractor furnished independent chemical cleaning company approved by the University's Representative.
8. Flush out the entire system for a period of not less than 4 hours to clear it of all loose material. Provide necessary cross-connections to loop system and circulate water for 24 hours. During this period, install 80-mesh screen in strainers and periodically clean. Drain the entire system. Refill system. Meter water when refilling to determine amount of chemical required in next procedure. Add trisodium phosphate (TSP) to achieve a uniform residual concentration of 10ppm. Circulate water for 48 hours. During circulation, periodically clean screens as required. Flush system for approximately 4 hours or until all traces of chemicals are removed. Remove 80-mesh screens.
9. For space heating hot water system, provide injection fitting and required connection piping to a 55-gallon chemical drum. Drum shall have provision for wall straps to safely secure to the wall. A chemical pump, controls and interval timer shall be provided.

Coordinate with electrical to provide required power for the pump. Coordinate with the plumbing engineer to provide sink and emergency shower/eyewash in mechanical room where water treatment will be performed. Run ¼" copper tubing from the water piping system to the sink with appropriate labels and service valves for collecting samples.

10. If water treatment is to be provided by UCLA Facilities (shall be determined during the design phase and indicated in the bid document), require a 30-day advance notice to Facilities. The piping system must be complete, pressure tested and cleaned. If water treatment has to be redone due to Contractor's incomplete work, extra services furnished by UCLA Facilities will be at Contractor's expense.

J. PRESSURE TESTING.
   1. All pressure pipe testing shall be done using a Bristol Recording Device. Hydrostatically field test pipe to 150 psig or 1.5 times the design pressures whichever is greater before insulating the field joints.

233100 HVAC DUCTS

A. Ductwork material, fabrication and installation shall be per SMACNA, HVAC Duct Construction Standards, Metal and Flexible, 2006, Third Edition except for the following:
   1. Fig. 2-2 Longitudinal Seams-Rect. Duct – Button punch snap lock is not acceptable. Use Pittsburgh lock 3/8-inch minimum pocket for rectangular ducts.
   2. Fig. 4-3 Vanes and Vane Runners – Double thickness vanes. Single vanes with trailing edge are acceptable. Trailing edge length shall be 3 times the vanes spacing.
   3. Fig. 4-6 Branch Connections – Straight Tap, Butt Flange and Dovetail joint are not acceptable. Use a 45-degree entry clinches lock. Use conical or bellmouth branch connections for round ducts.
   4. Fig. 7-2 Duct Access Doors – Use continuous piano hinge in lieu of butt hinge.
   5. Fig. 7-3 Access Doors-Round Duct – Split Sleeves are not acceptable.
   6. Fig. 4-2 Rectangular Elbows – Type RE-1 radius elbow shall always be used when space permits. Square throat elbows with double wall vanes (single vanes with trailing edge are acceptable) shall be used for supply ducts when space is limited.
   7. Fig. 3-2 Round Duct Longitudinal Seams – Snap lock seam is not acceptable.
   8. Fig. 3-1 Round Duct Transverse Joints – RT-3 Drawband joint and RT-5 Crimp Joint are not acceptable. Use RT-1 Beaded Sleeve Joints.
   9. Fig. 3-4 Round Duct Elbows – Pleated and Adjustable Elbow are not acceptable. Adjustable elbow may be used in duct pressure under 1-inch static pressure, only if sheet metal straps and screws are installed to lock elbow position and all joints and seams are sealed.
   10. Fig 3-5 90-degree Tees and Laterals – 90 degree Tap and Saddle Tap are not acceptable. Use 45-degree laterals or Conical Tees shown on Fig 3-6.
   11. Fig. 3-10 and 3-11 Flexible Duct Supports – Use 4-inch wide band in lieu of 1-inch band straps.
   12. Fig. 5-2 Upper Attachment Devices-Typical – Details 1, 3b, 4, 5, 7, 9, 10-, 11, and 14 are not acceptable.
   13. Fig. 5-4 Upper Attachments-Typical – This detail is not acceptable.
   14. Fig 7-11 Flexible Duct Liner Installation – Use only metal weld pins and 100% area coverage of adhesives. This also applies to rigid duct liners.
   15. Ducts shall be externally insulated and shall conform to Title 24 requirements.

B. Each duct transverse joint and longitudinal seam shall be sealed airtight using UL listed duct sealant in accordance with SMACNA Table 1-1 Duct Sealing Class A Requirements.

C. Pipe penetration of casing shall be sealed with a continuous weld per Fig. 9-14. Mastic sealant is unacceptable.
D. Where duct lining is installed downstream of static pressure dampers, mixing dampers, and volume dampers or at any point in the lined duct system where high velocity air may occur, provide perforated sheet metal lining to prevent erosion. This applies to all low, medium and high-pressure duct systems.
E. Provide “Hat-Section” for smooth laminar air flow in lined duct at each accessory, i.e., mixing dampers, volume dampers, fire/smoke dampers, etc. Also, on ducts with external insulation, provide “Hat-Section” to exposed quadrant of damper.
F. Adhere to AMCA recommendations.
G. Clearly indicate all ductwork to be insulated either in the drawing or specifications. Identify which ducts are to be acoustically lined.
H. Leak test all ductwork. Test shall be certified by a Balancing Agency (AABC member) to comply with the latest SMACNA HVAC Air Duct Leakage Test Manual.
I. All ductwork shall be designed so that it does not contribute to noise transmission between adjacent rooms.
J. Provide stainless steel supports for stainless steel ductwork. Galvanized supports for galvanized sheet metal ductwork.
K. Provide manual volume damper at all branch ducts. Install “HAT” section to expose damper quadrant in externally insulated ductwork. Provide tight sealing nylon bushings or grommets at duct openings for damper shafts under the hat section. Fill space under the “HAT” section with insulation. Cut slot in end of damper rod (quadrant end) to indicate blade position. Locate quadrant in accessible location. Provide access doors when located above inaccessible ceiling or remote-control mechanism in approved locations with proper labels.
L. Construct ductwork per SMACNA 2006 HVAC Duct Construction Standards, no substitutions or equivalency will be accepted.
M. In remodel work where more than two or three branches are to be demolished from the main duct, they shall be removed up to the main duct and the opening smoothly patched.
N. Provide air control valves in laboratories where air pressure relationship to be maintained is critical.
O. In hospital remodel projects in areas where existing lined ducts do not meet the current code requirement, provide all new ducts. Do not design for lining removal from existing ductwork.
P. Specify that exterior louver for mechanical systems shall be provided with galvanized hardware grade wire cloth, ½-inch mesh, 16 ga. Wire, 0.5-inch square opening, Galvanized after weaving.
Q. All seismic restraint of ductwork and equipment shall be per the California Building Code. SMACNA, NUSIG or engineered system prepared by a California licensed engineer experienced in seismic design are acceptable.
R. All welders shall be American Welding Society (AWS) or LA certified. Welding procedures shall be per AWS.
S. Exposed ducts shall only be held together using screw, duct tape is not permitted. Duct shall not have any markings.

233150 DRYER EXHAUST DUCTS

A. Any protrusion in exhaust duct is not allowed. Ducts shall be supported using SMACNA guidelines and joints shall be sealed to prevent leakage.

233300 AIR DUCT ACCESSORIES

A. Each volume damper - single blade type: use SMACNA Fig. 7-4 (Fig. A and Fig. C are not acceptable). For multi-blade volume damper, use SMACNA Fig. 7-5 (opposed blade action).
B. Follow SMACNA Fig. 7-4 and 7-4D for all details except as listed herein on single blade and two bladed damper for 2" W.G. class duct with end bearing.
C. Use 3/8" continuous square rod and 18 gauge galvanized stiffened blade for damper blade sizes 18" wide by 10" high and smaller.
D. Use 1/2" continuous square rod and 16 gauge galvanized stiffened blade for damper blade sizes 19" to 48" wide by 10" high. Maximum blade size is 48" by 10" high.
E. Maximum of two blades without a frame. Over two blades, use a manufactured 16-gauge galvanized steel frame. All hardware shall be galvanized except brass trunions and bronze oilite bearings: Pacific Air Products, Series 700; Pottorff Series 400; or equal.
F. Quadrant shall be Durodyne model 3/8" K-4/ 1/2" K-5 Quadline; Ventlox model 555 Ventline; or equal.
G. Provide closed end bearing, Durodyne SB-338 (3/8") /SB-312 (1/2"); Ventlox mode 609; or equal.
H. Cut slot in end of damper rod (quadrant end) to indicate blade position.
I. Volume dampers shall be identified by a bright orange colored ribbon attached to valve and freely hanging to ease in locating the device.

233400 HVAC FANS

A. Provide direct drive fans with VFD for all applications. Applications where use of a direct drive fan with VFD is not feasible shall be discussed with the University and an approved variance obtained in writing will be required. Belt drives may be permitted through the variance process.
   Belt drive configuration (if required) shall be AMCA arrangement 1, 9, or 10. High plume arrangement 9 fans shall feature a bifurcated housing with the motor, belt drive (if equipped), and bearings located outside of the contaminated airstream. Direct drive fan arrangements requiring access and handling of hazardous and contaminated fan components for motor replacement are not acceptable.
B. Exhaust Fans by – Greenheck, Cook, Twin City or equal.

233813 COMMERCIAL KITCHEN HOODS

A. Comply with 2019 CMC Chapter 5 Part I and II.
B. All kitchen hoods shall be listed and labelled according to UL 710, NSF 2 and NFPA 96.
C. Where multiple grease hoods are to be connected to one grease exhaust duct system, kitchen hoods shall be provided with adjustable baffle for balancing air flow between hoods. Adjustable baffles shall be an integral part of the hood.
D. Grease exhaust ducts shall be stainless steel 314 with welded seams and joints. Minimum SMACNA seal class shall be welded seams, joints and penetrations.
E. Duct construction shall be based on the system pressure.
F. All elbow fittings in grease exhaust ductwork shall be long radius elbow without turning vanes.

G. All grease exhaust ducts shall be airtight construction and pressure tested. Static pressure test shall be 3-in WC (or 1.25 times the system static pressure, whichever is larger) using air compressor and Schrader valve. When pressure stabilized at test pressure, duct pressure will be observed for one minute. Duct shall hold the pressure for at least one minute in order to pass pressure testing.

233800 BIOSAFETY LEVEL 3 (BSL-3) LABORATORY DESIGN STANDARDS JANUARY 2020 FOR MECHANICAL, ELECTRICAL AND PLUMBING

A. Refer to the latest UCOP requirements for BSL-3 rooms. Coordinate with UCLA PM for required design regulations.

233816 FUME HOODS

A. Where fume hood systems are included in building designs, obtain guide criteria from UCLA Environmental Health and Safety Office (EH&S). Follow the latest SMACNA Round Duct Industrial Duct Construction Standards and SMACNA Rectangular Duct Industrial Duct Construction Standards. Fume hood exhaust ductwork shall be 18 gauge, 18-8 stainless steel type 316. All joints, seams and connections shall be continuously heliarc welded with 18-8 stainless steel rod type 318-ELC. Elbows and angles shall have the same gauge as ductwork, inside radius not less than width of duct. Pitch all horizontal ductwork down towards fume hood. Fume hood duct bracing and support shall be 18-8 stainless steel type 316.
B. Fume hood exhaust fans shall be all welded steel and AMCA spark-proof construction. All surfaces in contact with the exhaust fumes shall be coated with baked-on Heresite, or equal.
C. The energy cost of fume hood operation must be carefully analyzed by the designer. Variable air volume and night setback systems shall be considered; however, such systems require special care in design and construction of the exhaust, supply and control systems to assure proper operation and maintainability. The designer will be required to present life cycle analysis comparing the recommended exhaust system to alternatives to demonstrate that the choice is appropriate considering first cost, energy and O&M costs.
D. Dispersion of the fume hood exhaust plume must be considered to avoid objectionable concentrations of chemical or biological hazards at habitable locations. This shall require wind tunnel studies or other special analytical techniques. Simple use of ASHRAE recommendations is probably not adequate for proper design.
E. Ducts used to convey products such as fume hoods shall be airtight construction. Static pressure test shall be the design static pressure of the duct system. Pass test by holding test pressure for one minute.
F. Fire or combination fire/smoke dampers are not allowed in fume hood exhaust duct.
G. Do not use flexible connection to fan. Use metal sleeve with packing.
H. Fume discharge shall be designed to achieve a minimum exit velocity of 3000 fpm, and elevated (exhaust stack) to prevent re-entry to the outside air intake of the building and adjacent buildings.
I. The average air velocity face of a hood intended for standard use shall be 100 linear feet per minute (fpm) with a minimum of 70 fpm at any measured point. Maximum face velocity

shall not exceed 125 fpm. Designers may design to 110 fpm, to allow for a margin of error in balancing.

J. Address code required operation of fume hood exhaust during emergency condition when supply fans are shut off while fume hood exhaust fans continue to operate. Significant negative pressure can occur in laboratory rooms making opening doors difficult for exit. Furnish alternatives for review by the Fire Marshal.
K. Specify Bellmouth connection to fume hood.
L. Hoods shall have transparent movable sashes constructed of shatter-resistant, flame-resistant material that is compatible with the materials and processes to be used in the hood, and capable of being moved to close the entire front face.
M. Vertical-rising sashes are preferred. If three or more horizontally sliding sash panels are provided, the panels shall be no more than 10 in. (25.4 cm) wide to allow them to serve as a safety shield narrow enough for a person to reach around to manipulate equipment. Multiple sashes may be installed within the same track. ANSI Z9.5 3.1.1
N. Sashes may offer extra protection to lab workers since they can be positioned to act as a shield.
O. A force of five pounds shall be sufficient to move vertically and/or horizontally moving doors and sashes. AIHA Z9.5 3.1.1
P. Sticky sashes and doors are not moved, so they become useless. These specifications result from decades of experience.
Q. Automatic sash closers with proximity sensors may be considered to allow for energy savings when the hood is not in operation. Note that a user's training program may be more effective in achieving this desirable end.
R. Sound absorbers, constant volume boxes, and other appurtenances shall be constructed of non-corrosive materials or stainless steel.
S. Laboratory air valves shall be pressure independent air flow control valve with either digital vortex shedding flow control (Phoenix or equal). Pressure loss through air valve shall be based on 0.3 in wg at design air flow.
T. Provide a low loss pressure drop duct sizing to reduce energy consumption. Duct sizing not exceed .1 in. w.g. per 100 ft of duct work and when possible, a .05 in. w.g. per 100 ft. duct work is advisable when conditions permit.
U. Air handlers for chemical fume hoods shall be connected to an emergency power system to maintain flow after a power outage. The fans must be configured to auto-restart so that fans will automatically restart upon shifting to emergency power. The overall ventilation system shall furnish at least half of the normal airflow during an electrical power failure.
V. Required by California Building Code for H occupancies.
W. Losses of power shall not change or affect any of the control system's set points, calibration settings, or emergency status. After power returns, the system shall continue operation, exactly as before, without the need for any manual intervention. Alarms shall require manual reset, should they indicate a potentially hazardous condition.
X. When the type and quantity of chemicals or compressed gases that are present in a laboratory room could pose a significant toxic or fire hazard, the room shall be equipped with provision(s) to initiate emergency notification and initiate the operation of the ventilation system in a mode consistent with accepted safety practices.
Y. A means such as a clearly marked wall switch, pull station, or other readily accessible device shall be installed to enable the room occupants to initiate appropriate emergency notification and simultaneously activate the ventilation system's chemical emergency (chemical spill, eyewash or emergency shower activation, flammable gas release, etc.) mode of operation if one exists.
Z. For rooms served by VAV ventilation systems, the Chemical Emergency mode of operation shall maximize the room ventilation rate and, if appropriate, increase negative room

pressurization. For rooms served by constant air volume (CAV) ventilation systems that utilize a reduced ventilation level for energy savings, the Chemical Emergency mode of operation shall ensure that the room ventilation and negative pressurization are at the maximum rate.

AA. Operation of the room ventilation system in a chemical emergency mode shall not reduce the room ventilation rate, room negative pressurization level, or hood exhaust airflow rate.

BB. A means such as a wall-mounted “FIRE ALARM” pull station or equivalent shall be installed to enable the room occupants to initiate a fire alarm signal and simultaneously activate an appropriate fire emergency mode of operation for the room and/or building ventilation system.

CC. For rooms served by VAV ventilation systems, the fire emergency mode of operation shall maximize the exhaust airflow rate from the hoods and other room exhaust provisions, and also reduce the room supply makeup air. For rooms served by CAV ventilation systems that utilize a reduced ventilation level for energy savings, the fire emergency mode of operation shall ensure that the maximum exhaust airflow rate from the hoods and other room exhaust provisions are in effect, and shall also reduce the room supply makeup air.

DD. Note, however, that ventilation supply/exhaust imbalance can make the doors extremely difficult to open. Consider programming in a short delay into the fire alarm system (30–60 sec or more) between activation of building evacuation alarms, and shifting the ventilation system to the fire-emergency mode of operation. This delay will allow occupants to evacuate prior to making the doors difficult to operate. The sequence of operations of the emergency ventilation response must consider the possible conflicting needs of smoke containment and emergency egress. The University Fire Marshal and the local EH&S office must concur on the configuration of the fire emergency mode of operation.

Hoods — Perchloric/Hot Acid Use

A. Where perchloric or other acids will be heated above ambient temperature, a dedicated acid hood shall be installed or provisions made to trap and scrub vapors at the point of emission, before they enter the laboratory ventilation system.

NFPA 45, Chapter 6-11.1

If perchloric acid is heated above ambient temperature, it will give off vapors that can condense and form explosive organometallic perchlorates. Limited quantities of perchloric acid vapor can be kept from condensing in laboratory exhaust systems by trapping or scrubbing the vapors at the point of origin. Nitric, hydrochloric, sulfuric, and other mineral acids are often used in digestion procedures at high temperatures.

B. Acid hoods and exhaust ductwork shall be constructed of materials that are acid-resistant, nonreactive, and impervious to the acid being used. No organic materials, including gaskets, shall be used in the hood construction unless they are known not to react with perchloric or other hot acids and/or their by-products;

ANSI Z9.5 3.2.4

NFPA 45, Chapter 6-11.2 and 6-11.5

Perchloric acid digestion will over time result in the condensation and consequential formation of metal perchlorate crystals, which can pose an explosion hazard, especially if combined with organic chemical condensate. Typically, 316 stainless steel or unplasticized PVC has been used. 316 stainless steel may not be appropriate for other hot acid applications, particularly hydrochloric acid. Consult with EH&S for guidance on the appropriate materials of construction of perchloric/hot acid digestion exhaust systems.

C. A water spray system shall be provided for washing down the hood interior behind the baffle and the entire exhaust system, including the stack and exhaust fan. It is not necessary to wash down the interior of the fume hood work area. The hood work surface shall be watertight with a minimum depression of 13 mm (1/2 in) at the front and sides. An integral trough shall be provided at the rear of the hood to collect wash-down water.
    NFPA 45, Chapter 6-11.6
        Perchloric/hot acid digestion hoods shall be washed down after each use to minimize accumulations of potentially explosive perchlorate salts and other highly corrosive by-products.

D. Wash-down spray nozzles shall be installed in the ducts no more than 5 ft apart. The ductwork shall achieve a positive drainage slope back into the hood. Ductwork shall consist of sealed sections, and no flexible connectors shall be used.
    NFPA, Chapter 6-11.4

E. The hood baffle shall be removable for inspection and cleaning.
    NFPA 45, Chapter 6-11.7

F. Ductwork for perchloric/hot acid hoods and exhaust systems shall take the shortest and straightest path to the outside of the building and shall not manifold with other exhaust systems. Routing shall be as vertical as possible.
    NFPA, Chapter 6-11.4
G. The exhaust fan shall be acid-resistant and spark-resistant. The exhaust fan motor shall not be located within the ductwork. Drive belts shall be conductive.
    NFPA 45, Chapter 6-11.3

236500 COOLING TOWERS AND CLOSED-CIRCUIT COOLERS

A. Preferred Vendor: BAC.
B. Thermal performance shall be certified by the Cooling Technology Institute in accordance with CTI Standard STD-201.
C. Sound performance ratings shall be tested according to CTI ATC-128 standards.
D. Unit structure shall be designed, analyzed and constructed in accordance with the latest edition of the California Building Code (CBC).
E. The entire unit, including fan motor and drive system, shall have a comprehensive 5-year warranty against defects in materials and workmanship.
F. The entire unit shall be constructed of Type 316L stainless steel for maximum equipment longevity and minimum water use. Series 300 or 301 stainless steel are not acceptable. Coatings of any kind are not acceptable.
G. Fans shall be low sound acoustical fan for sound reduction with no thermal de-rate. Fans shall be heavy duty non-corrosive Fiber Reinforced Polyester (FRP) or aluminum blade construction. FRP is preferred. Fans shall utilize a forward swept blade design. Each fan shall be dynamically balanced and installed in a closely fitted fan cowl with venturi air inlet for maximum fan efficiency.
H. PVC Drift eliminators shall limit the water carryover to a maximum of 0.001% of the recirculating water rate for water savings.
I. Water Distribution System:
    1. Counterflow Applications: Schedule 40 PVC spray header, branches, and riser with large orifice spray nozzles utilizing fluidic technology for superior water distribution over the fill media.

2. Crossflow Applications: Hot water distribution basins shall be open and gravity fed. Basins shall be accessible from the outside and serviceable during tower operation. Gravity flow nozzles shall be large orifice, snap in for easy removal.
3. Safeties: Provide a complete system in terms of shut off and directed flow to a drain in the event of unintentional water loss with alarm to Building or to the facilities automation system.

J. Heat Transfer Media:
   1. Open Cooling Towers: Bonded block fill media shall be constructed of PVC of cross fluted design and suitable for inlet water temperatures up to 120°F.
      a. Counterflow Applications: Bottom supported fill is suitable as an internal working platform.
      b. Crossflow Applications: Bottom supported fill allows 3" space between the bottom of the fill and pan bottom for cleaning. Drift eliminators are integral to fill media.
      c. Closed Circuit Coolers: Heat transfer coil shall be internally enhanced, elliptical tubes of prime surface steel, encased in steel framework with the entire assembly hot dip galvanized after fabrication. Coil assembly shall be air pressure tested to 390 psig. ASME/ANSI B31.5. CTI certified finned elliptical coils may be considered for additional water and energy savings.

K. 5-Probe Electronic Water Level Control Package with a NEMA 4X enclosure mounted in a cleanable Schedule 40 PVC external standpipe with slow closing solenoid valve(s) and "Y" strainer(s).

L. Pan strainer shall be Type 316 stainless steel.

M. Fan motors shall be totally enclosed, ball bearing type electric motor(s) suitable for moist air service. Motor(s) are Premium Efficient, Class F insulated, 1.15 service factor design. Inverter rated per NEMA MG1 Part 31.4.4.2 and suitable for variable torque applications and constant torque speed range with properly sized and adjusted variable frequency drives. Bearings shall have a minimum of L10 life for 100,000 hours.

N. Fan drive shall be multi-groove, solid back V-Belt type with QD tapered bushings designed for 150% of the motor nameplate power. Belt material shall be neoprene reinforced with polyester cord and specifically designed for evaporative equipment.

O. Unit shall be provided with vibration switch.

P. Access for maintenance shall include: Fan section access, basin section access, internal working platform, external service platform with ladder and safety cage, motor davit with base.

Q. The units shall have maintenance access such that one does not have to shut down any cells to perform maintenance on another tower.

R. Cold water basin shall be fitted with schedule 80 PVC sump sweeper piping with high flow educator nozzles to facilitate basin cleaning.

S. A basin cleaning side stream liquid solid separator shall be provided for proper filtration and maintenance.

T. Conductivity Based Automatically Controlled Evaporative Cooling Water Treatment
   1. Furnish labor, materials, tools, equipment and services for condenser water treatment.
   2. During design, obtain water samples from the project site and furnish laboratory analysis of the make-up water. Make-up water analysis to include the following analytics as a minimum:
      - Calcium Hardness (as ppm CaCO3)
      - Total Hardness (as ppm CaCO3)
      - Total Alkalinity or m-Alkalinity (as ppm CaCO3)
      - pH
      - Silica (as SiO2)
      - Specific Conductivity (micro S/cm)
      - Sulfate (as SO4)

- Chloride (as Cl-)
- Phosphate (as PO4)

3. Base the design of water treatment products, methods, and chemicals on:
   - The quality of make-up water available at the project site
   - Evaporative cooling equipment's materials of construction
   - Functional performance characteristics
   - Water savings goals
   - Applicable Code Requirements
4. Performance Criteria: Maintain the water conditions listed below:
   - Conductivity range of 300 to 5,000 micro S/cm.
   - pH range of 7.0 to 8.8
   - Local environmental regulations may dictate the highest pH permitted for blowdown. The conductivity setting can be adjusted by the balancing of fresh make-up water.
   - Total bacteria count (TBC) of less than 10,000 CFU/ml.
   - Keep condenser water system scale free and corrosion to levels acceptable by AWT guidelines.
5. Capacitive De-Ionization (CDI) Pre-Treatment Assembly shall be provided to achieve 6 cycles of concentration or more for minimum water use. Determine the maximum LEED point feasibility for LEED WE Credit, Cooling Tower Water Use. CDI and LEED design shall be based on the jobsite specific make up water analysis.
   a. Present the water analysis results, LEED point strategy, and the associated water treatment design(s) with cycles of concentration to the University Representative for review.
   b. Provide monthly service for the condenser water treatment program, including the necessary solid chemicals to minimize corrosion, scale formation, and biological growth.
   c. No liquid chemicals shall be used during normal water treatment operation. Liquid chemicals can only be used if required during passivation.
   d. Conductivity controller must have the ability to communicate with the Building Automation System.
   e. Open Cooling Towers Applications:
      - Skid mounted solid chemistry inhibitor feeder and bio-control granular feeder with conductivity controller, probe manifold, and motorized ball valve. No pumps shall be required to treat the condenser water.
   f. Closed Circuit Coolers Applications:
      - Solid chemistry inhibitor feeder and bio-control granular feeder shall be factory mounted on unit with conductivity controller, probe manifold, and motorized ball valve. No pumps shall be required to treat the condenser water.
   g. Contractor's Water treatment provider shall include consulting services and chemistry for a minimum period of 1-year from startup of the cooling system water treatment.

U. Manufacturers –Provide cooling towers manufactured by the following:
   1. Evapco, BAC or equal with Stainless Steel panels and any other component to protect against salt air/fog.

237323 CUSTOM CENTRAL STATION AIR HANDLING UNITS

A. Air handling unit manufacturer shall have accredited certification to current ISO 9001 standard.
B. Manufacturers –Provide Air Handling Units manufactured by the following:

Energy Labs, Temtrol or equal

C. Require UL or ETL listing and AMCA certified test for sound and performance.
D. Air handling systems that normally run 8 to 5 on weekdays and off on weekends are to be provided with morning warm-up controls.
E. All major components used to assemble air handling unit, with the exception of electrical devices, control dampers, drives, bearings, and controls, shall be manufactured by air handling unit manufacturer. Primary fans and coils not manufactured by air handling unit manufacturer is not considered single source responsibility and shall not be acceptable.
F. Drain pans shall be constructed from heavy gage stainless steel, insulated with 2 inches thick, 1-1/2 pound per cu. Ft. density insulation with a heavy gage galvanized steel liner.
G. After final assembly, the unit exterior shall be coated with an industrial grade, high solids acrylic and polyurethane paint. The paint system of outdoor AHU shall meet ASTM B117 salt/fog test for a minimum of 5000 hours.
H. Fan system shall consist of multiple direct driven arrangements and 4 plenum fans constructed per AMCA requirements for specified duty. Fan motor shall be premium efficiency totally enclosed air over, NEMA frame, and ball bearing type. Motor shall be designed for variable frequency drives service if controlled by VFD.
I. VFD shall be factory installed by the air handling unit manufacturer.
J. Chilled water and hot water coils shall be copper tubes with copper fins. Fins shall not be more than 10 fins per inch. Coils shall have counter-flow design, heavy gauge stainless steel casings and copper headers. Air velocity through coils shall not exceed 500 fpm.
K. Flow measuring stations shall be factory installed by the air handling unit manufacturer.
L. Outside Air Dampers, return, exhaust/relief Dampers shall fail to normal positions so that no damage will be incurred when fan is started manually. Dampers shall be low leak air-foil type with rubber edge seals and stainless-steel arc end seals.
M. Specify Filtration Group Aerostar FP minipleat filter, 12” deep, wet laid microglass, 85% efficiency based on ASHRAE 52.1.
N. Provide single source power panels that are constructed according to N.E.C. regulations and carry a U.L. 508 listing. Provide vapor tight marine lights in each access section, factory wired to a single weatherproof switch located on exterior of cabinet.
O. Provide weatherproof 15 amps, GFCI receptacle near the light switch wired to the lighting circuit.
P. Air handling unit shutdown:
    1. Unit or combination of units within a zone supplying air in excess of 2,000 CFM shall be equipped with automatic shutdown (CMC 608.0). Duct smoke detectors in main ducts, if used for shutdown, shall be clearly indicated on mechanical floor plans and control drawings.
    2. Unit supplying in excess of 15,000 CFM shall be provided with smoke dampers in main supply and return ducts to isolate the unit from remainder of the system (NFPA 90A). Multiple combination fire/smoke dampers at duct penetrations through shaft on every floor are not permitted to be used for unit isolation.
    3. Duct smoke detectors require special care in selection of the location and in installation in order to work properly and reliably and to pass required tests. The Fire Marshal will require testing of all duct smoke detectors as they have found in the past that many of them were not functional due to low air flow or turbulence at the installed location. Duct smoke detectors must be compatible with and operated by the installed building fire alarm system.
    4. Comply with NFPA 72E, NFPA 90A, NEMA Application and Installation Guide, CMC and CBC.
    5. Duct smoke detectors are specified under Division 26 including wiring and conduits. Mounting of detectors in ducts shall be specified under Division 23, and must comply with manufacturer’s requirements.

6. Duct smoke detectors are indicated on the mechanical drawings (by the design mechanical engineer). Prior to installing the duct detectors and when the air balance is completed, the Contractor's balancing agency shall test duct detector locations indicated on the plans to verify that air flow is laminar, and that air velocities and differential pressures are within the detector manufacturer's recommendations. For variable volume systems, perform test at minimum and maximum air flows. Record test data on attached form (Duct Mounted Smoke Detector Inspection Data). Submit test results to the University's Representative for approval.
7. Contractor shall furnish the services and coordination required for the testing of the duct systems to determine the proper placement of the duct detectors. This procedure shall be accomplished by the services of a Contractor-furnished air balance and testing agency which specializes in the balancing and testing of heating, ventilating and air conditioning systems. All work by this agency shall be done under direct supervision of a test and balance professional certified by the Associated Air Balance Council. Testing shall comply with NEMA Guide for Proper Use of Smoke Detectors in Duct Applications and NFPA 72E, and shall be witnessed by the Inspector.
8. When appropriate use UV-C lights and Bi-Polorionization devices. Coordinate with the needs of the building for Indoor Air quality, Cal-OSHA, UCLA EH&S and CDC guidelines for infection control. When required regulations are in conflict, the more stringent shall apply.
9. Where Air Handler are assembled on site, the contractor shall ensure the minimum leakage rate per manufacture guidelines.

238119 ROOF TOP UNITS AND ECONOMIZER

A. Trane or Equal.
B. My Fab Economizer.

238219 FAN COIL AND CONDENSING UNITS

A. Fan coil units shall not be located over expensive equipment such as electron microscopes, computers, etc. Fan coil units installed in furred spaces or attic shall have secondary drain pans beneath it to catch overflow drain in case of primary drain clog. Discharge drain to a point where it can be readily observed.
B. Provide access to fan coil units for routine preventive maintenance. This includes replacement of filter and belts accepted, repair of leaks, replacement of motors and controls. Provide all necessary work platforms where units are not directly accessible by a maximum 8-foot step ladder. Access panel shall be greater in size such that the largest removable component can be removed with ease.
C. Provide fan coil units with three speed motors wired to a three-speed switch. Design and size fan coil unit to operate at mid-speed. A speed control maybe preferred if the CFM supplied does not met the specified design CFM's.
D. Fan coil controllers shall be DDC and shall seamlessly communicate with the University Facility Automation System.
E. The condensing unit coil section shall be coated or copper finned to protect against salt fog/air.

DATA DISPLAY

(Observe upper and lower case letters)

Description	Engineering Units	Value Decimals	Display Example	Display COV
Air Changes	ACH	0	6 ACH	1
Air Flow	cfm	0	20890 cfm	100
Carbon DioxideCO2	PPM	0	423 PPM	50
Carbon Monoxide	PPM	0	22 PPM	1
Conductivity	u/S	0	12 u/S	1
Dewpoint	F	0	59 F	1
Differential Pressure	psid	0	9 psid	1
Filter Differential Pressure	“wc	1	0.5 “wc	0.1
Humidity on floor plan	%	0	75%	2
Humidity on schematic	%RH	0	43 %RH	2
Liquid Level	%Full	0	58 %Full	5
Position (valve, damper)	%open	0	60 %open	5
Static Pressure	“wc	1	1.5 “wc	0.1
Steam Pressure	psi	0	129 psi	5
Steam Flow/Steam Temperature	lbs/h	0	586 lbs/h	100
Temperature on floor plan	(none)	0	72	1
Temperature on schematic	F	0	57 F	1
Total Volatile Organic Compounds	TVOC	2	0.15 TVOC	0.05
Water Flow	gpm	0	234 gpm	10
Water Totalizer	GAL	0	33456 GAL	1000
VFD Speed	Hz	0	56 Hz	1

TEMPERATURE AND HUMIDITY

SPACE USE	OCC TEMP SET POINT RANGE (Deg F)	HUMIDITY SET POINT RANGE (%RH)	REGULATORY CODE	Trouble Call Alarm	Display Control Sensor	Blank Sensor
Area not listed below.	70 to 76	NA			X	
Aquarium	70 to 76	NA			X	
Audio Visual Equipment	74	NA				X
Classrooms, Computer	70 to 76	NA			X	
Classrooms, General	70 to 76	NA			X	

Classroom, Lecture Hall	70 to 76	NA			X	
Clean Room	68 to 73	NA			X	
Conference Room	70 to 76	NA			X	
Corridors	74	NA				X
Data Closet (IDF)	74	NA				X
Diagnostic Equipment	70 to 76	40 to 60			X	
Dining	70 to 76	NA			X	
Equip Rooms, Electrical	85	NA				X
Equip Rooms, Elevator	85	NA				X
Equip Rooms, Mechanical	85	NA				X
Exercise Room	74	NA				X
Gymnasium	74	NA				X
Kitchen & Food Prep	70 to 76	NA			X	
Laboratory, Wet or Dry	68 to 73	NA			X	
Lecture Hall	70 to 76	NA			X	
Library, Stacks	67 to 73	20 to 70	UCLA Library Dept.		X	
Library, Rare Books Store	70	40	UCLA Library Dept.		X	
Lobbies	74	NA				X
Music Rehearsal	70 to 76	NA			X	
Museum Gallery	70 to 74	45 to 55	UCLA Museum Dept	X	X	
Offices	70 to 76	NA			X	
Operating Rooms	68 to 73	20 to 60	CMC 2019	X	X	
OR Substerile	68 to 73	30 to 60	AAMI Standard 79		X	
Patient Prep - Recovery	70 to 76	NA	AIA FGI Guidelines		X	
Patient Sleeping	70 to 76	NA			X	
Public Area	74	NA				X
Restroom	74	NA				X
Server Room	74	NA				X
Storage, General	74	NA				X
Storage, Medical Supplies	74	20 to 70	AAMI Standard 79		X	
Storage, Museum Artifacts	68	45 to 55	UCLA Museum Dept		X	

Storage, -80 Freezer Farm	74	NA				X
Theater	70 to 76	NA			X	
Vivarium	70 to 76	30 to 70		X	X	
Workshop	70 to 76	NA			X	

ALARMS

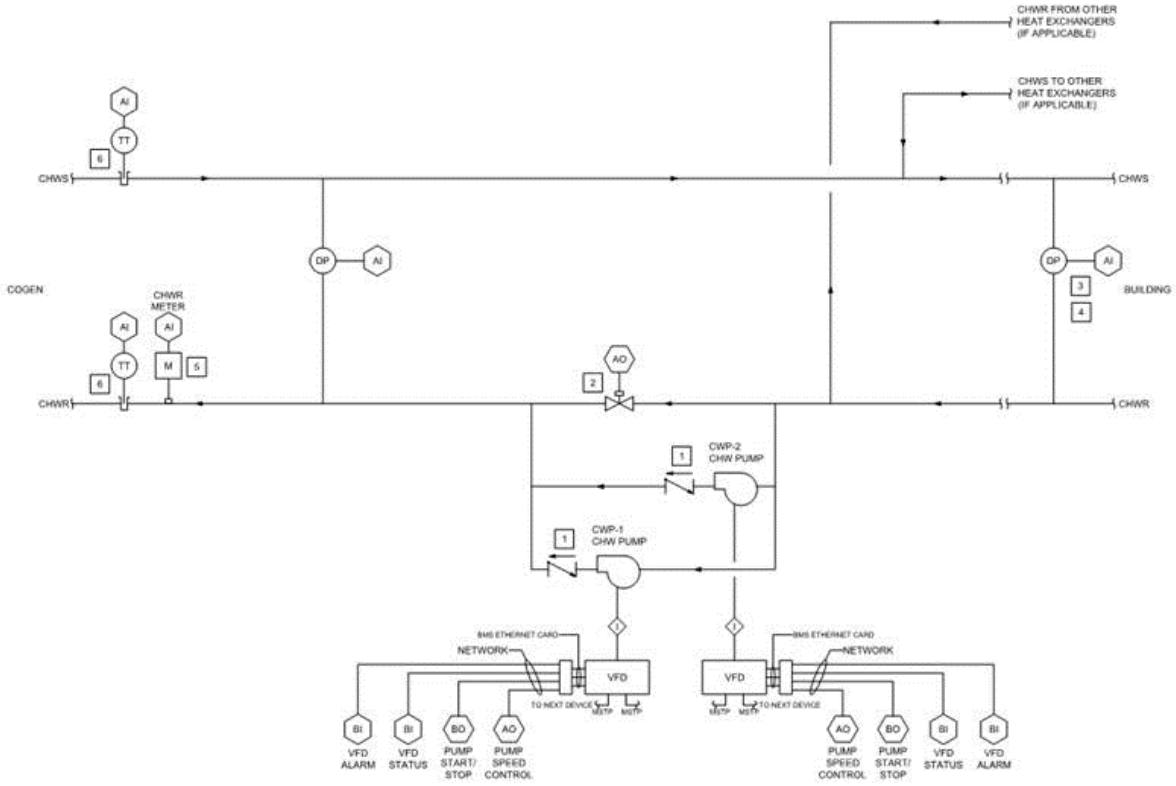
A. Critical Alarms

1. Critical alarms are implemented for life safety, property damage to building including damage by water and laboratory systems affecting critical research.
2. The Campus control system will automatically send a remote notification (RENO) to prelisted responders by email or text message.
3. Alarms are also sent to the Trouble Desk (TD) that is operated 24/7. A dedicated monitor in the Trouble Call Center will display the alarm.
4. The alarm will be acknowledged by the TD operator and recorded on a paper log. The TD operator will call the listed responders to validate they received the alarm.
5. The TD operator will initiate a trouble call work order for Facilities Management staff follow-up. Any necessary repairs will be made and the trouble ticket closed out.

B. Operation Alarms

1. Operational alarms include filter status, CO2 values exceeding predefined limits, events that do not happen within a time limit, etc.
2. These alarms shall NOT be programmed or implemented in the Campus control system.

C. Building to Campus water loop connection


CHWR FROM OTHER HEAT EXCHANGERS (IF APPLICABLE)
CHWS TO OTHER HEAT EXCHANGERS (IF APPLICABLE)
AI
TT
6
CHWS
DP
AI
BUILDING
3
4
COGEN
CHWR METER
M
5
AO
2
CHWR
1
CWP-2 CHW PUMP
CWP-1 CHW PUMP
BMS ETHERNET CARD
NETWORK
VFD
TO NEXT DEVICE
MSTP
BI
VFD ALARM
VFD STATUS
BO
PUMP START/ STOP
PUMP SPEED CONTROL

26 00 00
ELECTRICAL STANDARDS
JULY 2023

26 00 00 ELECTRICAL

260000 GENERAL REQUIREMENTS

1. The term CEC through-out this document refers to the current University-identified California Electrical Code edition.

2. All manufacturers and part numbers indicated on this document shall be followed by the word “or equal” when included in the specifications. Design Standards provide basis of design manufacturer and part number and do not intend to uniquely identify any manufacturer.

3. Consultants engaged in designing photovoltaic “PV” systems shall show proof of experience designing this system for a period of time not less than 5-year.

4. PV Systems design documents shall include a sequence of operations script in order to be approved. No exceptions.

5. Consultants engaging in data center design shall size the electrical infrastructure for the full capacity based on UPS rating.

6. Structural details for conduits seismic, bracing and expansion shall be specified. Drawings won’t be approved without structural details.

7. Existing and new breakers 100A and above shall be tested and labeled “passed” by a third party company before using them. Test results shall be submitted to University Representative for review and approval.

8. Design Standards are developed to assist the engineer in the preparation of the contract documents.

9. Design Standards are intended to supplement and take precedence over any sample specifications as to the basis of design for type and quality that shall be included in the contract drawings and specifications.

10. Design Standards shall be reviewed and incorporated by the engineer through the specification writer and any questions shall be directed to the University Representative.

11. Furnish underground systems studies including cable pulling in 3-D if proposed ductbank’s routing exceeds 36” below finish floor.

12. Specifications shall include information or data for ONLY systems, equipment and materials that are in the scope of work of that particular project. General design documents will not be accepted by the University.

13. Substitution of materials by the project Contractor shall be reviewed with the University Representative, prior to being approved. Materials indicated in the standards have been determined to be “TYPE” and “QUALITY” best suited for University projects.

14. Furnish indoor and outdoor photometric calculations on new or remodel projects where light fixtures and light poles are changed/added. Photometric calculations are required for both normal and egress conditions.

15. As required by CEC Article 110, no foreign systems shall be placed in any electrical room unless dedicated to the electrical room, vault or areas designated for electrical or communication equipment. Review the architectural design as to type and location of plumbing fixtures on the floor above to determine that no piping is required below the floor.

16. Lighting calculations on approved lighting compliance forms shall be placed on plans for review and approval by UCLA Capital Programs. The certificate of compliance shall be signed by the person responsible for its preparation. All new construction shall comply with the 2022 California Energy Commission Building Energy Efficiency Standards.

17. All materials shall bear the UL label and shall comply with the requirements of the National Electrical Manufacturers Association (NEMA), ANSI, Institute of Electrical and Electronic Engineers, and Institute of Power Cable Engineers Association.

18. All equipment and lighting schedules must be shown on the plans, not on the specifications. The plans become University's permanent record, and are referred to for maintenance and operations purposes. The specification book is not a readily accessible record.

19. Load balance: the design shall maintain not more than 5% load (KVA/Amps) difference between phases.

20. Engineering software for power system studies acceptable by the University; SKM Power Tools for Windows or by Etap, or equal.

21. Electrical cabinets shall be sheet steel in conformance with CEC Article 312 requirements, with 3/4-inch fire retardant plywood backboard inside and on the back of the cabinet.

22. The design team shall obtain the approval from the University's Representative for the Proposed Building Service Size during 100% Schematic Design.

23. Master clock outlets may be required in corridors, auditoriums and public spaces. This requirement shall be coordinated through the project manager for the specific project. The clock system is wireless and the clocks specified must be compatible.

24. Provide conduit boxes, fittings, and necessary power for emergency telephones as required on the exterior grounds of the buildings. Telephone instruments and housing shall be determined by UCLA Information Technology Services. Telephones shall be connected directly to UCLA Police Station.

25. Any deviance from project specifications shall be communicated in writing through respective product shop drawing specification (typically this is performed by Contractor's provider by adding the word "comply" or "deviate" next to each spec section). In addition, product data sheets shall highlight all parts intended to provide. Otherwise, the University may not review the submittal and will be returned to the Contractor to complete.

26. Surge-Protective Devices (SPDs) are required in new projects. UL1449, type 2 SPD must be installed on the load side of the service disconnect overcurrent protection or main gear, and type 3 SPDs on the load side of a branch circuit overcurrent protective device. At least one UL1449 type 2 for commercial and institutional buildings is required. Data Centers require up to three levels. The design engineer to propose and justify the number of SPD levels that are required for the new design.

27. Load monitoring documentation is required for existing switchboards and panels where new loads are being added. The University may ask for two levels of load monitoring in some cases. In addition, a partial or complete existing single-line diagram shall be included. OTC (Over the counter) remodeling and addition projects documentation will become the building record drawings, therefore, existing panels and devices remaining in the new scope of work shall be clearly identified on plans along with existing circuitry. OTC projects will be rejected if not complied.

28. Investigate design and manufacture of existing special systems in the UCLA CHS (Center for Health Sciences). Unless overriding considerations exist, provide (subject to University approval) system in the new facility to match such special systems as:
    a. Isolated power (anaesthetizing areas, invasive procedures, surgeries).
    b. Grounding systems in surgical, recovery or special patient care spaces.
    c. Intercom Systems.
    d. Nurse Call Systems.
    e. Medical Gas Alarm Systems.
    f. Fire Alarm System.
    g. Master Clock System

29. Conductor supplying power conversion equipment (VFD's) shall comply with CEC 430.122. VFD's will also require input wiring and motor wiring to be routed through separate conduits.

30. Conductors shall be sized per CEC sections 210 and 215

31. If approved by University, additional meters maybe required to achieve LEED "Savings by Design" requirements.

32. Capital Programs will furnish 15KV available fault current (AFC), voltage, and X/R values at the service point of connection.

REQUIREMENTS FOR EXISTING BUILDINGS:

A. Most of these buildings are over 20-years old with an aging electrical system still in operation. Before starting new scope of work/remodeling, the engineer is to evaluate existing installation conditions and furnish a complete report and recommendations to whether they agree to continue using it or not. A third-party may be hired to do so. The report is due on/or before schematic design (SD).

B. The University requires copper bus bars equipment and conductors for new installations. If Aluminum equipment distribution is to remain in place, new conductors to comply with CEC Section 314 which allows aluminum conductors AA-8000 series for branch circuit up to 8 AWG. In addition, the University requires two-hole compression connectors.

DOCUMENT PREPARATION:

A. All plans require stamp, signature and expiration date by the California registered electrical engineer responsible for their preparation.

B. Legends, schedules, and notes shall contain only items and information that are in the scope of work of that project.

C. Construction documents (CDS) shall include riser-diagrams for each system with respective equipment interconnection. One-line for normal and emergency systems, ground riser, fire alarm and special systems (Telecomm, PA, security, PV systems, etc.).

D. All feeders shall show indicated length within 5' accuracy and voltage drop values.

E. All distribution equipment (i.e., service switchboard, distribution boards, panelboards, motor control centers, variable frequency drives, and disconnect switches, etc.) shall indicate the Available Fault Current (AFC) and design “KVA” it serves on the single-line diagram.

F. Electrical plans shall indicate conduit routing of both medium (12.47kV) and utilization voltages (208V and 480V).

G. All conduits shall be sized and shown on one-line drawing(s) and/or as required to clarify respective system design intention. If drawings are not clear, the University may ask for additional riser.

H. Electrical drawings shall include electrical rooms in ¼ “scale showing complete equipment layout as well as equipment clearances per CEC Article 110.

I. As-built record drawings are extremely important to the ongoing operation of the facility, but are often neglected in the crisis of construction. The engineer and UCLA inspector shall verify at each site visit that the Contractor is maintaining adequate “as-built”, and shall obtain progress copies of the Contractor’s “as-built” during construction. At the completion of the project generally, it is too late to verify concealed work and documents are often misplaced.

J. Specifications shall be prepared to include only systems/items and materials that are in the scope of work for this project. Review and coordinate each specification section for consistency with information shown on plans.

REPORTS AND CALCULATIONS:

A. Reports:
1. Preliminary short circuit analysis.
2. Voltage drop considering 80% of the selected feeder capacity through-out.
3. Load flow study considering design loads through-out. (Where new distribution is provided only)
4. Data centers shall include harmonics studies.
5. Furnish generator's size report using software by CAT or equal. (Where new emergency distribution is provided only)

B. On Drawings:
1. Total service size connected and demand load (KVA/Amps). Show a table on single line diagram.
2. Switchgear/ switchboards UL listing, i.e. UL-67, UL-891 design intention, and load schedules including connected and demand loads (KVA/Amps)
3. Complete panel schedules.
4. UPS/Battery calculations
5. For existing facilities, existing panels shall include a table showing panel existing load plus new load will be added (Minimum 3-day and up to 7-day load monitoring asdetermined by the University's Representative)

260513 MEDIUM-VOLTAGE CABLES

Cables shall be new 15 kV rated EPR 133% insulated, single conductor and 25% overlap tape shield shall be provided. The Contractor shall be required to submit cable splicer qualifications to University's Representative for approval. Cables shall be factory-tested. Factory test reports shall be submitted to University's Representative for approval prior to installation. Upon delivery to the site, cable shall be examined for mechanical injury prior to installation. After installation, cable shall be hi-pot tested to specifications. Field test reports shall be submitted to University's Representative for approval. Cables shall be identified as to phases and feeder designation. Basis of design product for MV cables: The Okonite Company.

Standard radial distribution conductors size to be 250MCM. Standard loop distribution conductors size to be 500 MCM. Splices shall be made with molded rubber straight separable connectors rated 15 kV, 600 A. Separable connectors to be Elastimold or equal. Separate set of connectors shall be provided at each manhole. Contractor to coordinate connectors' type (i.e. Straight, T or L) with University's Representative before purchasing. Straight connector may not be applicable in some cases, therefore, provisions of them per application. The University may refuse connectors purchased by Contractor without coordination.

Minimum Conductors size for transformers 500KVA, 15kV and below to be # 2 AWG.

These sections shall be modified only with specific concurrence from Capital Programs.

260519 LOW-VOLTAGE ELECTRICAL POWER CABLES

Feeders serving lighting and miscellaneous power loads must be of greater capacity than required by Applicable Code Requirements with final rating to be reviewed and approved by the University's Representative to allow for future growth. All Conductors shall be copper, THW or THHN/THWN for 600 Volts or less. Feeders serving Motor Control Centers shall be sized as required by Applicable Code Requirements plus 25% spare capacity. Basis of design for low voltage cables: The Okonite Company.

260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

Provisions for grounding shall be according to CEC Article 250. If manholes are required, provide ground rods 3/4"x10' at each manhole, ground conductors and conductor shields (if splices are made) shall be connected to ground rods by approved connectors. All 15KV cables in manholes shall be spliced with 15KV Elastimold or equal connectors. Grounding conductors for campus loop distribution to be # 3/0 AWG (600V) and for radial distribution 1/0 AWG. (600V).

Special circumstances (CHS System only): grounding systems in surgical, recovery or special patient care spaces shall be compatible with existing CHS grounding system.

260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

A. Rigid Steel Conduit shall be used where exposed to weather, and in areas susceptible to damage and for high and low-voltage feeders inside the building. In addition, rigid conduits must be installed in the main electrical room (Normal and emergency).

B. Electric Metallic Tube may be used in concealed spaces up to 1½" maximum size. Compression type connectors only.

C. Flexible Steel Conduit (Aluminum Flex Not Allowed): Short runs from ceiling J-Boxes to light fixtures, final connection to motors or other appliances and equipment (use Liquid-Tight in damp locations) or where special permission is granted for use.

D. Conduits shall be 3/4" minimum, except for single circuit branches, which dead-ends into light fixtures and receptacles, which may be 1/2". UCLA Information Technology Services requires 1-1/4" minimum for telephone/data.

E. Use PVC Schedule 40, encased in concrete, for runs outside the building. At building entry points (inside building) provide tags on all conduits clearly stating "CAUTION -- HORIZONTAL RUNS EXTERIOR TO BUILDING ARE PLASTIC. GROUND CONDUCTOR REQUIRED".
   1. All nonmetallic feeder conduit installed underground shall be encased in a 3-inch concrete envelope. Duct bank shall be steel reinforced at building entry points. Extend concrete envelope a minimum of 3 inches beyond external sides of outermost conduit. Space the external surfaces of conduit within a bank, a minimum of 3 inches apart, except that all sound, telephone, and intercommunication circuits contained within nonmetallic conduit shall have minimum separation of 12 inches from any light or power

circuits that parallel them within a bank. Use manufactured concrete or plastic spacers to ensure required concrete coverage. Concrete shall be 2500 psi. Structural details must be included on structural drawings.

2. Concrete for conduit and duct banks containing high-voltage cables (above 600 volts line-to-line) shall have "red oxide" added to the wet concrete mix to achieve a distinctive red color to the entire concrete envelope. Red Oxide shall be added to the wet mix in the proportion of 8 pounds of red oxide per yard load. Concrete color shall be subject to approval of the University Representative.
3. Duct lines shall have a continuous slope downward toward manholes and away from buildings with a pitch of not less than 4 inches in 100 feet. Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet. Manufactured bends may only be used at ends of short runs (100 feet or less).
4. High voltage cable shall be installed with a maximum of 2-90 degrees bends between manholes or pull boxes.
5. Backfill material for site utilities below paved areas (streets, parking lots, walkways) shall be one-sack cement slurry, up to the underside of the finished pavement. In planting areas, slurry shall be up to 24 inches below finished grade, then backfilled with compacted native soil to finished grade.
6. Provide high duct bank reinforcement below streets crossing. Reinforcement shall be extended 15’ to 20’ before and after the cross section. The installation and specifications shall comply with UCLA Electrical distribution system expansion 6A and 6B Projects. Underground high voltage duct-bank installation is subject to UCLA approval

F. Conduit supports shall be as required by SMACNA guidelines. Seismic restraint shall be provided for suspended conduits 2 inches and larger.

G. Surface raceway: Metal Raceway shall be used for surface distribution of branch circuit electrical wiring and cabling for voice data, multi-media, low voltage and optical fiber. A complete raceway system includes raceway, covers, mounting hardware, various fittings and outlet boxes installed at specific locations. Compliance to Applicable Code Requirements and standards is required for installation, grounding and bonding and cable deployment. Metallic raceway shall be Hubbell series 500, 750, 2000, 3000, 4000, 6750, ALU 3800/4800 or equal, as applicable. Utilize Hubbell Metal pre-wired PlugTrak or equal, where practical.

H. Non-Metallic Surface Raceway, boxes, and fittings can be utilized only as indicated per drawings. Non-metallic raceway shall be Hubbell series PT1, PP1, PL1, PW2, PB2, PB3, PS3 or equal.

260536 CABLE TRAYS FOR ELECTRICAL SYSTEMS

A. Use of cable tray requires specific approval of the UCLA Information Technology Services, and is strongly discouraged. It would be allowed only as a last resort. If permitted, cable trays must be fully enclosed with side access and conduit drops from the tray to workstations. Other types of wire ways, such as underfloor duct, shall only be used with special approval. Only enclosed wireways shall be permitted, and must be plenum-rated where used in ceiling plenums.

B. All conduits attached to cable tray shall be bonded to the tray per CEC 250.8

260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

The following color code prevails for all branch circuits and feeders:

	120/208V	480/277V
Neutral	White	Gray
Phase A	Black	Brown
Phase B	Red	Yellow
Phase C	Blue	Purple
Ground	Green	
Switch Legs	Same as phase leg	
Three Way Travelers	Orange	

260573 OVERCURRENT PROTECTIVE DEVICE SHORT CIRCUIT AND COORDINATION STUDIES AND ARC FLASH HAZARD ANALYSIS

A. The specifications shall require the Contractor to furnish a short circuit study, coordination study and arc-flash hazard analysis to be submitted for approval by the University Representative prior to equipment submittal. The studies shall be prepared by a California registered electrical engineer. The short circuit study shall be based on criteria preset by design engineer. All equipment in the power system shall be rated to withstand 110% of available short circuit current at equipment location. Short circuit current, together with the equipment short circuit rating, shall be indicated for all equipment on the Contractor'sElectrical Single-Line Diagram. Electrical distribution system shall be fully rated (series rating is not allowed). The Coordination study shall verify that the power system is coordinated with upstream and downstream devices. The Arc Flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2021, Annex D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (substations, switchboards, switchgear, motor-control centers, panelboards, busway, etc.) where work could be performed on energized parts. The Arc- Flash hazard analysis shall start at medium voltage through 480V locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than125 kVA. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering incident energy of 1.2 cal/cm^2. The Arc- Flash hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors tobe operating under full-load conditions. Upon approval of the Arc Flash Study by the University Representative, Arc-Flash hazard warning labels shall be produced and applied to the electrical equipment. Coordination study and Arc Flash hazard analysis shall be based on actual distribution equipment being provided, and shall be reviewed and approved by the University prior to the building being energized with permanent power.

B. Distribution equipment shop drawing submittals final approval is subject to approved power systems studies by the University Representative. Even if approved before the power systems studies are, Contractor is liable to update equipment ratings and others per systems studies results and recommendations.

C. Contractor shall mitigate incident energy levels to Category Level 2 and below without additional cost to the University. Reduction methods such as adjusting trip settings, addition of optical relays and Arc Flash Reduction Maintenance Switch (ARMS) or their combination may be used. Reductions Methods (RM) often bring significant add-cost during construction's phase to have installed; therefore, the design team shall furnish directions; whether in the specs or one-line drawings that Reduction Methods cost are included in the project's scope of work. If omitted, the University is not liable for any additional cost relatedto RM parts and/or work involved. Consultant may be liable for missing its implementation.

260620.16 ELECTRICAL PANELBOARD SCHEDULES

All equipment and lighting schedules must be shown on the plans, not on the specifications. The plans become the University's permanent record, and are referred to for maintenance and operations purposes. The specification book is not a readily accessible record.

261000 MEDIUM-VOLTAGE ELECTRICAL DISTRIBUTION

A. Power for most projects located on the main campus and the southwest campus is provided from the campus power distribution system, not directly from Los Angeles Department of Water & Power (LADWP) or Southern California Edison (SCE). For these projects, there shall be no reference in the construction documents to the utility company.

The UCLA main campus has multiple distribution voltages: 4.8 kV and 4.16kVsystems, which currently serve CHS are being phased out with the new 12.47 kV distributionsystem already in place.

Service transformer primary windings shall be 12.47 kV except in project sites where the available source is still 4.8kV (dual voltage 4.8 kV and 12.47 kV shallbe specified for initial connection to the 4.8-kV system and later reconnection to the 12.47kV loop system with reconnection capabilities from one voltage to the other). Minimum two 2-1/2% taps above nominal and two 2-1/2% taps below nominal voltage shall be providedon the 12.47 kV windings. The secondary voltage shall be as determined most feasible in the design of the project. Transformers shall be sized based on connected load. Only code-approved demand factors will be allowed.

B. The campus 12.47 KV loop distribution is served via double-ended switchgear from the Cogen Plant. Each loop serves multiple SF6 switches (daisy-chained) with the one set of conductors terminating in one end, and the second set in the other end giving more reliability to the campus power network. Based on the project load requirements, the University will furnish directions or assist the Contractor about the new service feed provisions. This includes a loop expansion by adding to the scope of work a new SF6 switchwith two poles dedicated to the loop (In and out of the switch) or a radial feed from existing SF6 switch. If a new SF6 switch is decided, a minimum of one spare pole shall be required. New buildings will be fed from the 12.47 KV loop system and service conduits shall not use any part of the loop infrastructure (pull-boxes and/or spare conduits installed for the loop system). New service feed will have

its own path (trenching) from SF6 switch to respective building and will run in a separate trench away from 12.47KV loop U/G system. No exceptions.

261116 SECONDARY UNIT SUBSTATIONS

Provide substation(s) with primary load break switch and primary fuses, Envirotemp FR-3 high fire point biodegradable fluid transformer equipped for future fan-cooling and metal-claddraw-out secondary circuit breakers, quantity as required. For indoor installations, transformer with cast coil primary and secondary windings is preferred. Solid insulation inthe transformer shall consist of inorganic materials such as glass fiber, electrical grade epoxy and Nomex. The average temperature rise of the transformer windings shall not exceed 80 degrees C when the transformer is operated at full nameplate rating. Thetransformer(s) shall be capable of carrying 100% of nameplate kVA rating in a 40 degrees Cmax. 30 degrees C average ambient as defined by ANSI C57.12.00. High- and low- voltagewindings shall be copper. The designer shall select a “K” factor for the transformer based on the non-linear and linear load analysis. Secondary breakers shall be equipped with long time, short time and instantaneous trip, and ground-fault protection, as well as test block for attachment of external recording instrumentation. Substation secondary main breakers shall be provided with Arc Flash Reduction Maintenance Switch that has multi-setting adjustment of peak-sensing arc flash current levels. The trip unit shall have this Arc Flash Reduction switch integrated using an enabled/disabled setting along with a blue indicating light to remind the maintenance personnel to re-engage the normal setting once maintenance is completed. Provide arc reduction maintenance switch for those feeder breakers ≥ 400AT supplying power to main lugs distribution boards. Substation transformer shall be factory tested as specified in NEMA publication TR1-2013 (R2019) and ANSI Test Code for Transformers. Furnish complete test reports for University’s Representative approval. Factory testing of substation and major electrical equipment as determined by the University shall be witnessed by the University Representative. Specifications must contain language requiring Contractor to notify the University Representative thirty days in advance of factory tests. For secondary unit substations 1000 kVA and above, specifications shall include “University Representative to witness equipment manufacturer test procedure at manufacturing testing location” Contractor to consider University Representative travel and accommodation expenses as needed.

261319 MEDIUM-VOLTAGE SWITCHES

The consultant shall obtain a copy of the latest sample specification sections for 15 kV rated SF6 sectionalizing switches and 15kV- rated load interrupter air switches from Capital Programs. SF6 switches shall be designed specific/unique to the project conditions, complete with wiring compartment and pull boxes integral to the switch. A spare position shall be provided in every sectionalizing switch. The sections shall be modified only with specific concurrence from Capital Programs.

262213 LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

A. Transformers shall be sized based on connected load. Only code-approved demand factors will be allowed. Provide copper primary and secondary windings as well as copper lug pads for primary and secondary terminators.

B. Dry-type transformers (used only for 480V step-down to 208Y/120V) shall be NL and NLP series for non-linear loads. "K" rating for non-linear plus building loads combined and "K-4" to IT server rooms.

C. Energy efficiency for transformers rated 15 KVA and larger shall comply with DOE 10 CFR PART 431 Appendix "A" of Subpart K 2016.

D. Special circumstances: transformers shall be compatible with existing CHS Isolated power system (anaesthetizing areas, invasive procedures, surgeries.)

262413 SWITCHBOARDS

A. Factory testing of switchboards, and major electrical equipment as determined by the University shall be witnessed by the University Representative. Specifications must contain language requiring the Contractor to notify the University Representative thirty days in advance of factory tests.

B. Main and distribution switchboards shall be of same manufacture throughout and shall meet UL Standard UL-891 and NEMA Standard PB-2. All switchboard bussing shall be copper. Main service switchboard section shall be fifty inches deep, and shall be dead front and rear, 90 inches high, capable of floor standing, front and rear accessible. A ground bus shallbe furnished, minimum 25% ampacity of main bussing. Adequate space shall be provided to permit addition of a future switchboard of equivalent size. Switchboard main breakers ≥ 400AT shall be provided with Arc Flash Reduction Maintenance Switch that has multi-setting adjustment of peak-sensing arc flash current levels. The trip unit shall be compatible to work with the Arc Flash Reduction switch or integrated (if available) using an enabled/disabled setting along with a blue indicating light to remind the maintenance personnel to re-engage the normal setting once maintenance is completed. Provide arc reduction maintenance switch for those feeder breakers ≥ 400AT supplying power to main lugs panelboards. Low voltage switchboard(s) shall be Eaton Pow-R-Line C switchboard. Provide Eaton PowerXpert 6000 with display for service entrance main switchboards, substation secondary main switchboards or where metering 2000A or greater. For compliance with Title 24 disaggregation of loads, provide for the grouping of common type load breakers using Eaton type IFS switchboard or PRL-C switchboard with space for future CT's integrated into the vertical distribution section bussing. For those switchboards where disaggregation is not practical, utilize Eaton's PowerXpert PXMP multi-point metering system for monitoring each branch circuit in compliance with Title 24 disaggregation exception.

262416 PANELBOARDS

Panelboards shall be UL listed. All bussing shall be copper. Ground and neutral bus shall be provided in all panelboards. Isolated ground bus, where required, shall be provided. Door-in-Door trims shall be provided with concealed trim and no exposed trim hardware withthe panelboard door closed. Piano hinge and similar exposed hinge arrangements are not acceptable. Circuit breakers shall be industrial type. Arc Fault Circuit Interrupting (AFCI) circuit breakers, where required by the California Electrical Code, shall be provided. AFCI breakers shall meet UL 1699 requirements and shall be listed and labeled per this standard.

Combination-type AFCI breakers shall be specified and shown on plan drawings. AFCI breakers shall be self-test design and include integral ground fault protection, 20A 1-pole 120VAC, Eaton type QBCAF or equal for panelboards and Eaton type BRCAF, or equal for residential load centers . For compliance with Title 24 disaggregation of loads, provide for the grouping of common type load breakers in dedicated panelboards per the Title 24 requirements. Alternately, provide the grouping of common type load breakers in Eaton's PRL-4 or equal power panel with space for future CT's integrated into the vertical bussing. For those panelboards where disaggregation is not practical, utilize Eaton's BCM Branch Circuit Monitoring or equal system for PRL-1a, PRL-2a and PRL-3a panelboards. Panelboards shall be provided with a minimum of 20% spare capacity in terms of circuits and connected load. Panelboard enclosures shall be sized to accommodate 42 circuits minimum.

262419 MOTOR-CONTROL CENTERS

A. Factory testing of control centers and major electrical equipment as determined by the University shall be witnessed by the University Representative. Specifications must contain language to require the Contractor to notify the University Representative thirty days in advance of factory tests.

B. Motor Control Centers of Class II Type B construction shall be provided. Motor starters shall be of the "MCP" (Motor Circuit Protector Type), draw-out construction, and each starter shall be equipped with its own control transformer, providing 120 volt control. Control transformer sizes shall be per manufacturer's recommendations. All motor control center bussing shall be copper. Each starter shall be equipped with hand/off/auto switches and pilot lights or other appropriate devices as required by control considerations. Provide Eaton type C441M, or equal solid state overload relay with Modbus. Include all accessories as required to meet requirements of mechanical control diagrams. A copper ground bus of 25% ampacity of main bus shall be furnished. Motor Control Centers shall be of the same manufacturer as the switchboard.

262713 ELECTRICAL METERING

A. Each secondary breaker shall be equipped with an Eaton PXM-6000 or equal as detailed in the metering specification. Eaton meters and gateways are the UCLA electrical metering standard for uniform compatibility and communication with existing and future campus-wide electrical system metering and monitoring, including compatibility with Eaton PowerXpert Software.

B. For metering total power of distribution switchboards or individual branch breaker load metering, provide Eaton PM-3 or equal where available or IQ-2270 or equal where PM-3 is not available. All metering devices shall communicate via Incom to be compatible with existing meters or shall connect to Eaton PowerXpert Gateway. All projects shall include Eaton PXG-600 or equal gateway – one provided for each electrical room where metering devices are located/installed in equipment.

C. Provide meters for applications where metering of a panelboard is needed to comply with CA Title 24 and LEED certification energy measurement. For metering total power at a panelboard, provide Eaton IQ-35 or equal. For metering individual small panelboard branch

breaker loads provide Eaton type BCM or equal metering system. All metering devices shall communicate via Incom as to be compatible with existing meters or shall connect to Eaton PowerXpert Gateway. All projects shall include Eaton PXG-600 or equal gateway – one provided for each electrical room where metering devices are located/installed in equipment. Panelboards shall be of the same manufacturer as the switchboards.

262726 WIRING DEVICES

A. Convenience Receptacles shall be heavy duty design, 20-Amp, 125-volt with one-piece brass integral grounding strap, brass bypass power contacts, external wiring clamps, rynite base and nylon face. Emergency receptacles shall be red in color. Receptacles shall comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 and FS W-C-596. Receptacles shall be Eaton/Cooper 5361 (single), AH5362 (duplex) or equal.

B. Hospital Grade Receptacles shall be heavy duty corrosion resistant design 20-Amp, 125- Volt with one-piece nickel plated brass integral grounding strap, nickel plated brass bypass power contacts, secondary nickel plated brass ground contacts, rynite base and nylon base. Receptacles shall comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd and FS WC-596. Receptacles shall be Eaton/Cooper 8310 (single), AH8300 (duplex) or equal. Emergency receptacles shall be red in color, Eaton/Cooper 8310 (single), 8300 (duplex) or Hubbell HBL8300 series or equal.

C. Ground Fault Circuit Interrupting Receptacles (GFCI) shall meet UL943 requirements. GFCI receptacles shall be NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS WC-596, 20-Amp, 125-volt and shall be self-test design, with whole system test functionality, surge immunity and noise filtering. GFCI receptacles shall be Eaton/Cooper VGFH20 Hubbell Autoguard Series GFR5352ST or equal. Hospital grade GFCI receptacles shall be Eaton/Cooper VGFH20/AH8300 Hubbell Series GFR8300ST or equal.

D. Switches shall be heavy duty design 20-Amp, 120-277 Volt AC, corrosion resistant steel nickel plated bridge, one piece integral grounding terminal with #8 brass screw, stainless steel automatic grounding clip, one piece rivet-less copper alloy spring contact arm and terminal plate, large silver cadmium oxide contacts. Back wire shall be terminated at receptacle external bundling terminals, voiding pigtail. Switches shall be Eaton/Cooper AH1221 (single pole), AH1222 (two pole), AH12233 (three way), AH1224 (four-way) HubbellHBL1221 series or equal. Pilot-Light Switches, 20A Eaton/Cooper AH1221PL (120 V and 277 V) or equal.

E. In hospital or medical facility construction, receptacles shall be hospital grade. Emergency light switches shall be red in color. Cover plates for emergency lights and receptacles shall be red nylon.

F. Occupancy/vacancy sensors shall be used to control lights wherever practical. Sensors shall incorporate both ultrasonic and passive infrared detection technologies. Dual technology sensors furnish the most reliable means of automatic lighting control. PIR Sensor shall be suitable for the control of LED. Sensors shall have a ½ HP rating and shall bear the UL marking – UL244A. Sensors must be California Title 24 compliant – Manual On/Auto/Off operation, selectable time delay of 5 seconds (test), 5 minutes, 15 minutes, and 30 minutes for lights to remain on after room is vacated. Sensors to have a minimum coverage of 180 degrees and 1000 sq. ft. Sensor lens shall be tamper-resistant reinforced Fresnel type. Sensors shall be Eaton/CooperOSP10M Sensors Hubbell Adaptive Technology Sensors

ATD, ATU, ATP Series or equal.

263213 ENGINE GENERATORS

The generator shall be sized at a minimum of 120% of required capacity. Emergency power shall be supplied for elevators, electrical and signal room lights and outlets, generator room/enclosure lights and outlets and all code-required outlets. Where there are multiple elevators in a bank, it is acceptable to provide capacity for one elevator per bank with a method for switching the emergency power to each elevator. On-site fuel supply shall be capable of running the generator for 10 hours minimum. For generators 1000 kVA and above as well as paralleling gears 5000A and above, specifications shall include “University Representative to witness equipment manufacturer tests procedure at manufacturing testing location”. Contractor is to consider UniversityRepresentative travel and accommodations expenses as needed.

CHS EMERGENCY POWER:

Emergency switchboards, motor control centers, panelboards and automatic transfer switches shall meet UCLA's specific requirements and standards in terms of Critical, Life Safety and Equipment branches (“A”, “B” and “C” priorities). Special labeling designation of new electrical equipment connected to the emergency power system, to conform to the existing labeling system, shall be obtained from Capital Programs. Any new load added to the emergency system shall be subject to “load capacity verification” per requirements of the California Electrical Code (CEC) and the capacity limits of the existing emergency system. Also, voltage drop in the emergency system is a critical factor. ATSs close transition shall beprovided for branches A and B.

265500 SPECIAL PURPOSE LIGHTING

A. Interior lighting shall comply with the above-mentioned C.E.C. Title 24 documentation. Light levels shall be in accordance with latest Illuminating Engineering Society (I.E.S.) recommendations. Illumination calculations shall be furnished for review and approval by UCLA Capital Programs.

B. Lighting shall be designed for optimal conservation of energy. LED fixtures shall be specified.

C. Recessed lensed light fixture shall be 5” deep to reduce lamp image, spring-loaded latches, and mitered doorframe, hemmed over side rails and built in earthquake clips. Doorframe shall be regressed aluminum with virgin acrylic lens thickness of .125 inch. Doorframe shall be interchangeable with a 1” deep silver specular louver doorframe. Fixture shall beLightolier SPS series, Prudential 8600 series or equal.

D. Surface mounted wrap shall be .187-inch lens and shall be Lightolier CBS series, Prudential 1600 series or equal.

E. All down lights shall be horizontal lamping for maximum efficiency and housing shall be made of aluminum construction. Cutoff shall be 55 degrees or better. Fixture shall be Lightolier Calculite series, Staff Spec series or equal.

F. For parking garage use Cree Edge series Lighting Catalog # ARE EHO-3M/3MB-HV-LV-12-E-UL-700mA-40K-ML or equal and for parking lots use pole lighting by CREE Lighting Catalog

ARE EHO-2M-AA-D-UL1000mA-40K/DIM or equal.

G. Exit lights shall be made of extruded aluminum and shall have a depth of no greater than .65" and edge lite shall have a depth no greater than 1.5" low profile design. Lamps shall be of LED source. Lettering shall be red with white housing or red lettering on a clear panel. Fixture shall be Lightolier EX or DX series, Evenlite Sovereign or Razor series or equal. Not-equal for gym facilities only shall be approved by the University's Representative

265600 EXTERIOR LIGHTING

Exterior lighting shall be Sternberg B750 Avenue Series. Fixture shall have the VCOB LED module with a 4000K color temperature and a minimum 70 CRI or better. LED shall offer a minimum life of 100,000 hours at L70. Fixture shall have a wattage of 56 and lumens per watt shall be 111 or better. Metal Halide is limited to certain specific areas, which shall not be expanded, to match existing lighting. Low Pressure Sodium shall not be used. Fixture driver shall be high efficiency with a THD less than 20% and a high-power factor greaterthan .9 and be capable of a 0-10v signal. Pole shall be 6200 Oxford Series and a standard height of 12ft. Pole (10' and 14' optional height) shall be a cast tapered fluted pole with a one-piece decorative heavy wall 356 alloy cast aluminum base. Fixture and pole shall be painted a Dark Bronze Smooth finish. Consult with UCLA Capital Programs before selecting styles of luminaires and poles. Light levels shall be in accordance with latest Illuminating Engineering Society (I.E.S.) recommendations, upper range. Illumination calculations shall be furnished for review and approval by UCLA Capital Programs. Outdoor LED lighting shall be UL Listed and approved by the University's Representative.

263000 FIRE ALARM SYSTEM

A. The campus fire alarm system includes fire alarm systems in each building that report over a dedicated wireless to a central monitoring system that reports to the Campus Police dispatch center. The central monitoring system is a Keltron Life Safety Event Management System that annunciates fire alarm activations to UCPD and supervisory, trouble and student room smoke detector activations to UC trouble desk. Wiring to the central monitoring goes via telecommunications facility located in Campus Services Building I. In order to interconnect with the central system and to maintain a degree of commonality among systems, there are three compatible manufacturer's systems which are acceptable for the general campus. These are Keltron, Johnson Controls, Siemens and Notifier. There are standard provisions for interconnection of these systems from the Fire Alarm Control Panel (FACP) in a building to the Keltron system, which must be specified for inclusion in the FACP. The actual connection from the FACP will be made by Facilities Management, so the Contractor's scope will end at the FACP. Because so many details of the fire alarm system are critical to compatibility with the campus system, the designer shall obtain and use the latest version of sample specification furnished by the campus engineer's staff. This section shall be modified only with the specific concurrence of Capital Programs. For fire alarms in the CHS complex see separate CHS section below.

B. The Fire Alarm/Life Safety system shall be Johnson Controls 4100ES or Notifier 30/30, Siemens XLS to match existing campus systems. The fire alarm/Life Safety system shall report to the Keltron work station located in the UCLA Police Station (UCPD) via Keltron wireless radio Life Safety event management system located in Room 3171J of Facility

Management Building. The cable connection interface to existing shall be made by UCLA. The Contractor shall provide a complete, functioning system which shall be approved by the California StateFire Marshal, and which meets campus requirements per UCLA Campus Fire Marshal.

C. The FACP shall be fully field programmable and shall be programmed to achieve the outputs as follows for transmission to the main monitoring system at the Campus Police Station (each signal shall be prefixed by building identification number):
   1. Manual alarm: Energize and close upon activation of any manual station of the system.
   2. Autoalarms: Energize and close upon activation of any automatic alarm (i.e.: smoke detector, heat detector, duct detector, etc.).
   3. Waterflow alarms: Energize and close upon activation of any waterflow alarm.
   4. Common trouble: Energize and close upon activation of any supervisory alarm or system trouble.
   5. Subsequent trouble: FAIL-SAFE REPORTING/OPERATION: De-energize and close upon activation of any unacknowledged supervisory alarm or system trouble on the system.
   6. Student room smokes

D. Each type of alarm noted above shall activate a CSFM listed fire alarm signaling relay, which will interface with the campus central reporting system. Each relay shall be identified as indicated above. A relay module shall be provided with as many relays as necessary to perform all functions.

E. The system shall be provided with an annunciator and remote operator panel, to be installed at a location recommendedby the designer and approved by the University's Representative and the Campus Fire Marshal during design. The Campus Fire Marshal is a designated representative of the California State Fire Marshal (CSFM) and will also coordinate with the L.A. City Fire Department. The specific type of annunciator (graphic vs. matrix) shall be coordinated with the Campus Fire Marshal for the particular building. A complete sequence of operations chartshall be provided on plans, along with a riser diagram and floor plans showing all devices.

F. Construction documents and Contractor submittals shall use NFPA standard fire alarm symbols.

G. Duct Smoke Detector are specified under Division 26, however, they shall comply with 23 00 00 Mechanical Specs for mounting and manufacturer's power requirements. Duct Smoke Detectors shall activate the FACP as a "FIRE" alarm NOT as supervisory alarm.

H. Before final signoff by UCLA Fire Marshal and Inspectors the following functions must be programmed, tested and approved into each panel:
   1. Horn/speaker strobe bypass
   2. Elevator recall bypass
   3. Fan/damper shutdown bypass
   4. Door release bypass
   5. Waterflow/tamper bypass

   The following will also need to be provided:
   1. A copy of the program/points list for the fire alarm systems
   2. "As-Builts" for the fire alarm and fire sprinkler systems
   3. NFPA 72 Certificate of Completion for the fire alarms system
   4. Contractors Material and Test Certificate for aboveground and underground piping (fire

sprinkler system)

5. Ensure Hydraulic plates are installed for each sprinkler system at building prior to sign off

CHS FIRE ALARM:

A. The CHS, which includes all of the interconnected buildings in the School of Dentistry, School of Public Health, South Tower and School of Medicine complex, is considered to be a single building for purposes of fire alarms. The CHS uses Notifier NFS2-3030 fire alarm panels with voice evacuation (evac). All panelsshall be networked together and report to the Fire Command Center in room 12-213. The designer shall obtain specific technical details for the CHS networked Notifier Fire Alarm System from Capital Programs.

B. Fire Alarm Systems in the existing shall be Notifier NFS2-3030 fire alarm panels with voice evac and compatible network hardware to connect with the CHS Notifier fire alarm network.

C. New Fire Alarm system integrated with existing campus fire alarm shall be permitted only if new Fire Alarm complies with UL 864.

SYSTEM DESCRIPTION AND FUNCTION

A. The system shall consist of power supplies, interface with remote fire alarm panel, on campus, remotely mounted building annunciator panel(s), automatic detection devices, manual reporting stations, speakers with ADA strobes, and all wiring. The entire system shall be equipped with an emergency battery back-up system. The system shall be fully field programmable.
B. The system shall be capable of operating both addressable and non-addressable devices.
C. The Contractor shall provide the services of the approved fire alarm manufacturer to program the Fire Alarm Control Panel (FACP) for the new building system.
D. Fire alarm system wiring shall be Class B.
E. The system shall function as follows under an alarm condition:
   1. Sound the alarm and cause visual signals to flash on all floors of the building.
   2. Automatically notify the Campus Police Station with one of the signals
   3. Display individual addressable device number on Liquid Crystal Display (LCD) annunciator in the fire alarm control panel with University's Representative defined message. Contractor shall request any necessary clarification prior to initiating any programming on the system.

      Examples of University-defined messages are shown below:

      DEVICE ABBREVIATIONS
      DUC = Duct Detector
      HD = Heat Detector
      M = Manual Station
      PRS = Low air pressure (typical for pre-action system)
      TAM = Tamper switch
      TBL = Trouble
      SD = Smoke Detector (Integral with door closer)
      SMK = Heat Detector
      WF = Water Flow
      BD = Beam smoke detector

      TYPICAL LOCATION MESSAGES

      Do not abbreviate if possible. Activated devices shall be designated by floor # with notations of either in or at a room number/elevator, lobby/stairwell or other clearly identified location

33 00 00
UTILITY STANDARDS
JULY 2023

33 00 00 UTILITIES

330000 GENERAL REQUIREMENTS

A. DOCUMENT PREPARATIONS
1. Legends, schedules, and notes shall contain only items and information that are in the scope of work of that project.
2. The construction documents shall include riser-diagrams for each piping system, i.e. sanitary waste and vent, storm drain, both domestic and industrial hot/cold water, laboratory waste, medical gases, fuel gas, fire protection, chilled water system, process cooling water system, steam and space heating hot water system.
3. All piping shall be sized and shown on the plan of the floor level in which it will be installed.
4. Show on the plans, composite building sections, as needed to verify that all components will fit as shown on the plans. Indicate ducts, pipes, conduit, fan coils units, recessed light fixtures, structural beams soffits etc. at each critical location where such elements cross.
5. Location of all shutoff valves and cocks must be shown on the floor plans in addition to the riser diagrams. Valves or cocks shall be shown at each branch takeoff from a main and at each group of fixtures and each piece of equipment (in addition to the fixture stops). Adequately sized access panels must be designated for all concealed valves and cocks.

AS-BUILT DOCUMENTS

As-Built Drawings: In addition to requirements specified in Section 01 78 39, Project Record Documents: Record the following information on the As-Built Drawings:
   a. Locations of Work buried under or outside the building, such as plumbing and electrical lines and conduits. Furnish horizontal and vertical dimensions from fixed points.
   b. Actual numbering of each electrical circuit.
   c. Locations of all HVAC, plumbing and electrical Work concealed inside the building; and other work that is changed by Contractor from that shown on the Drawings.
   d. Locations of all items, not necessarily concealed, which vary from the locations shown on the Drawings.
6. Specifications shall be prepared to include only systems, items and materials that are in the scope of work for this project. Review and coordinate each specification section so there will be no contradicting information of specified items or materials.

B. DRAWINGS AND CALCULATIONS
1. Show all calculations on drawings: hydraulic water calculations and pipe sizes, sump and sewage ejector pump size calculations.
2. 1/4 inch scale or larger equipment, restrooms and shower rooms showing each major piece of plumbing equipment and fixtures.
3. Show pipe riser diagrams complete with pipes sizes and appropriate unit values: water fixture units, drainage fixture units, GPM, CFH, etc.
4. All equipment schedules shall be shown on the plans, not on the specifications. The plans become the campus' permanent record, and are referred to for maintenance and operations purposes. The specification book is not a readily accessible record.
5. Specification title and numbering shall be based on Master Format (version as approved by University's Representative) and content shall be in CSI 3-part format (Part 1-General, Part 2-Product, and Part 3-Execution).
6. Plumbing specification sections shall have separate sections, independent of mechanical and fire protection specification sections.
7. Plumbing details to be included in the plans (when applicable):

a. Equipment and piping supports including seismic bracing installed inside and outside the building. Include wind load for exterior installation.
b. Vibration isolation and seismic restraints
c. Pump piping detail
d. Equipment drains. Provide hose end connections to all drain valves. Drain valves above finished ceiling shall be provided with chained cap.
e. Concealed or exposed pipe penetrations through walls, floors and roof. Coordinate with the architect's drawing.
f. Underground storage tank
g. Equipment housekeeping pad

Nomenclatures.

A.	CHW	Chilled Water
B.	CHWR	Chilled Water Return
C.	CHWS	Chilled Water Supply
D.	CR	Steam Condensate Return
E.	FH	Fire Hydrant
F.	FW	Fire Water
G.	HPS	High Pressure Steam
H.	LPS	Low Pressure Steam
I.	NG	Natural Gas
J.	SD	Storm Drain
K.	SDMH	Storm Drain Manhole
L.	SS	Sanitary Sewer
M.	SSMH	Sanitary Sewer Manhole
N.	W	Domestic Water

LEED and SUSTAINABILITY

A. GREEN BUILDING POLICY COMPLIANCE
1. All projects must comply with the UCLA Campus Green Building Baseline Standard and must meet the UC-equivalent of the USGBC "LEED Silver" with a target of Gold. A copy of the latest baseline standard shall be obtained by the designer. Some of the baseline requirements that have particular MEP impact include:

a. Water efficiency and conservation in compliance with CalGreen.
b. In addition to the baseline requirements, each project must consider the additional USGBC LEED criteria that may be feasible to attain a minimum LEED "certified" rating for the project.

331000 WATER UTILITIES

A. GENERAL REQUIREMENTS
1. Domestic and fire protection water for all projects located on both the main campus and the southwest campus is obtained from the campus water distribution system, not directly from LADWP. For these projects, there shall be no reference in the construction documents to an outside utility company. The project engineer shall contact UCLA Capital Programs' Engineer, not DWP, for location, size, availability, and pressure of campus mains.
2. Domestic water service connection into a campus water main shall have a full size (main) shut-off valve on each side of the project service tee and a shut-off valve on the service. These three (3) valves shall be flanged to the tee. Where a single service valve is required, it shall be flanged by MJ, bolted to a flanged tee. There shall be no hot tapping into campus water mains. All shutdowns of campus mains shall be done by Facilities Management staff. A backflow device is not required for a domestic water service.
3. Fire sprinkler service connection into a campus water main shall have a full size (main) shut-off valve flanged on each side of the project service tee, with no valve on the fire service.
4. The designer must consider the impact of connections to general campus utilities and existing building systems and furnish instructions to maintain service continuity and limit shutdown duration. Coordinate the responsibility for making the connection with the University.
5. Location of hydrant(s) shall be coordinated and approved by the University Fire Marshal and coordinated with Campus Utility drawings.
6. Provide meters for domestic, industrial and irrigation water lines. Water meter requirements are described in plumbing specification sections. Water line to fire protection systems is not required to be metered.

B. PRODUCTS
1. Piping. Cement-lined Class 350 ductile iron pipe and compact pattern AWWA C-153 fittings shall be specified for any domestic or fire service water piping below grade (3-inch and larger) with Mechanical or Tyton type joints. Sizes 2 ½-inches and smaller shall be type "K" hard drawn copper pipe with brazed joints. Copper pipe shall be wrapped. Ductile iron pipe shall be encased in Polyethylene per ANSI/AWWA C105/A21.5.

C. Valves.
1. Several valve manufacturers carry separate domestic and import lines. The import lines are often of inferior quality. Where a specification refers to such a manufacturer, the specification writer shall verify that the valve model numbers specified are for the domestic made valves and not the import line of the manufacturer.
2. A full size flanged 3-valve cluster shall be indicated at all domestic and combined water main interconnection points. A valve on a dedicated fire service shall not be indicated. Installation of each valve should be detailed to include two (2) #6 rebar, over the flanged tee (not the valve) and imbedded in 24" x 24" x 18" thick concrete anchor base.
3. Valves shall be specified as : A.W.W.A. cast iron body, resilient seat, non-rising stem, 200 PSI rated working pressure.

D. Fire Hydrant.
   1. Fire hydrants shall have a 6-inch inlet connection to the main and shall have one 2-1/2 inch hose connection and one 4-inch pumper connection. Threads shall be National Hose Thread standard. The hydrants shall be James Jones Co. Model J3700, all bronze, to match existing campus hydrants, and shall conform to AWWA C-502. The hydrant bury shall be one piece ductile iron. Paint hydrants one coat of industrial exterior primer paint and two finishing coats of industrial exterior OSHA yellow enamel paint to match the color of existing campus hydrants. Hydrants shall have 6-hole flange and a 1-1/8 inch operating nut. There shall be a shut-off valve indicated between 5 and 15 feet from the hydrant.

E. EXECUTION
   1. Earthwork. Backfill material for site utilities below paved areas (streets, parking lots, walkways) Sand shall be 12 inch above pipe then backfilled with 1.5 sack cement slurry up to sub-grade elevation. In planting areas, Sand shall be 12 inch above pipe, then backfilled with compacted native soil to finished grade.
   2. Piping for landscape irrigation between the campus main and the irrigation backflow – P.R.V. Station shall be the same material as water/fire mains.

F. Piping Installation.
   1. Only concrete thrust blocks bearing on undisturbed soil shall be used for thrust containment on all below-grade water lines (Domestic and Fire protection). Retainer glands shall be noted as not acceptable. Minimum size ¾ inch tie rods may be used if first approved by the University's Representative.
   2. All types of underground piping shall be protected against corrosion in accordance with ASTM A674 or AWWA C105
   3. All tie-rods, clamps, brackets or other below-grade supports or restraining devices shall be galvanized and also coated with heavy-duty bitumastic material. Submit coating material for approval by University representative.
   4. A full size flanged 3-valve cluster shall be indicated at all domestic and combined water main interconnection points. A valve on a dedicated fire service should not be indicated. Installation of each valve shall be detailed to include two (2) #6 rebar, over the flanged tee (not the valve) and imbedded in 24" x 24" x 18" thick concrete anchor base.
   5. Valves shall be specified as : A.W.W.A. cast iron body, resilient seat, non-rising stem, 200 PSI rated working pressure.
   6. Below-grade piping shall not be supported directly on backfilled soil compacted or not. Structural supports shall be provided if piping is not installed on undisturbed soil.
   7. The drawings shall indicate that any existing water piping below grade that is to be abandoned or removed shall be capped, plugged or flanged at the shut-off valve that controls that line.
   8. Dead leg branches on water lines shall be cut back as close as possible to the mains.

G. Field Quality Control.
   1. Testing. The following tests by the Contractor are required for site water distribution systems.
      a. All testing and chlorination of new site water mains shall be done prior to the final connection to the existing University mains.
      b. Pressure test: After the pipe is laid, the joints completed and the trench partially backfilled, leaving the joints exposed for examination (center load the pipe), the newly laid pipe or any valved section of piping shall be subjected to a pressure test of 250 psi static pressure for a period of four (4) hours at the points of reading. Test shall be

recorded using a Contractor-furnished Bristol recording device. Start and stop test in the presence of the University's Representative.

c. Contractor to provide adequate thrust containment during testing. A blank flange (cookie) may be installed at system POC shutoff valve.
d. Leakage test: Perform the leakage test in accordance with the requirements of American Water Works Association, Inc. (AWWA) Standard C-600.
e. Contractor shall provide "tee" fittings (not hot tap) required to introduce and flush out the disinfectant agent.

H. Disinfection of domestic water, industrial water and fire lines.
1. General: All newly installed water systems and lines shall be disinfected by a Contractor-furnished commercial water line chlorinator. The commercial chlorinator shall also take water samples for bacteriological analysis. These samples shall be submitted to a California state licensed testing laboratory by the chlorinator.
2. Incurred Costs: All expenses that may result from the disinfection and testing of water systems and lines, and the taking and analysis of water samples shall be borne by Contractor.
3. Advance Notice: Contractor shall notify University's Representative and the UCLA Office of Environment, Health and Safety (EH&S), at least 72 hours in advance of all disinfection and testing procedures. All disinfection and testing procedures shall occur in the presence of an EH&S representative. Notification shall include location, number of chlorinations and tests, day and time.
4. Labor and Materials: Contractor's chlorinator shall furnish labor, equipment, materials and transportation needed to correctly disinfect and test domestic and laboratory hot/cold water systems and fire lines and to take water samples for bacteriological analysis. This includes all items needed to facilitate the introduction of the disinfecting agent into the water systems/lines such as service cooks and valves.
5. Disinfecting Agents: Chlorine is approved for water system disinfection and may be used in gaseous or liquid form. Other types of disinfecting agents may be used only with the prior approval of University's Representative.
6. Disinfecting Procedure: The disinfection of water systems and lines shall be in accordance with the requirements of Title 22, California Code of Regulations (CCR) and the American Water Works Association (AWWA) standards. The disinfecting procedure shall include the following:
    a. Post signs on all water outlets of the system being disinfected reading "Water System Being Chlorinated – Do Not Drink" or similar warning.
    b. With system full of water and under "main" pressure, open all faucets to permit simultaneous trickle flow.
    c. Introduce the disinfectant into the system until a test of the water at each outlet shows a free chlorine residual concentration of:
        - 50 parts per million (ppm). This chlorine concentration shall be held in the pipes for a 24 hour period; or
        - 200 ppm. This chlorine concentration shall be held in the pipes for a 3-hour period.
    d. The test made of the water after the retention time shall indicate a chlorine residual concentration of not less than half of the original concentration. Repeat the disinfection procedure until this standard is attained.
    e. After satisfactory completion of the above test, flush out system until diethyl-p-phenylenediamine (DPD) tests at the water outlets reveal that the free chlorine residual is less than 0.5 ppm or equal to the flushing water chlorine residual.

I. Water samples for Bacteriological Analysis:
   1. Water samples for bacteriological analysis shall be collected by Contractor's chlorinator in sample bottles prepared as required by Title 22, CCR and AWWA standards. Samples shall be taken from a representative number of water outlets so as to ensure an accurate sampling of the water system/line. Water samples shall be taken in the presence of an EH&S representative (University may also collect a sample).
   2. The water samples shall be delivered by Contractor's chlorinator in a timely manner to a California state approved water analysis laboratory. The samples must test negative for coliform organisms and less than 500 for a Standard Plate Count (HPLC).
   3. If the results are positive, the above steps 6(a) through 6(e) shall be repeated. Two consecutive negative tests must be obtained prior to using the water system.

J. Final Results: Submit a copy of the laboratory analysis to the University's Representative and EH&S. If the analysis results do not meet the standards specified, the disinfecting procedure shall be repeated until the specified standards are met, at no additional cost to University. The complete procedure may take up to 4 days if negative results are obtained. This procedure will be longer if the results are positive.

333000 SANITARY SEWERAGE UTILITIES

A. GENERAL REQUIREMENTS
   1. Provide a two-way cleanouts & Jetter Access Point on waste exiting the building.
   2. Building sewer shall be provided with cleanouts located not more than 100 feet apart measured from upstream entrance of the cleanout.

B. PRODUCTS - NOT USED

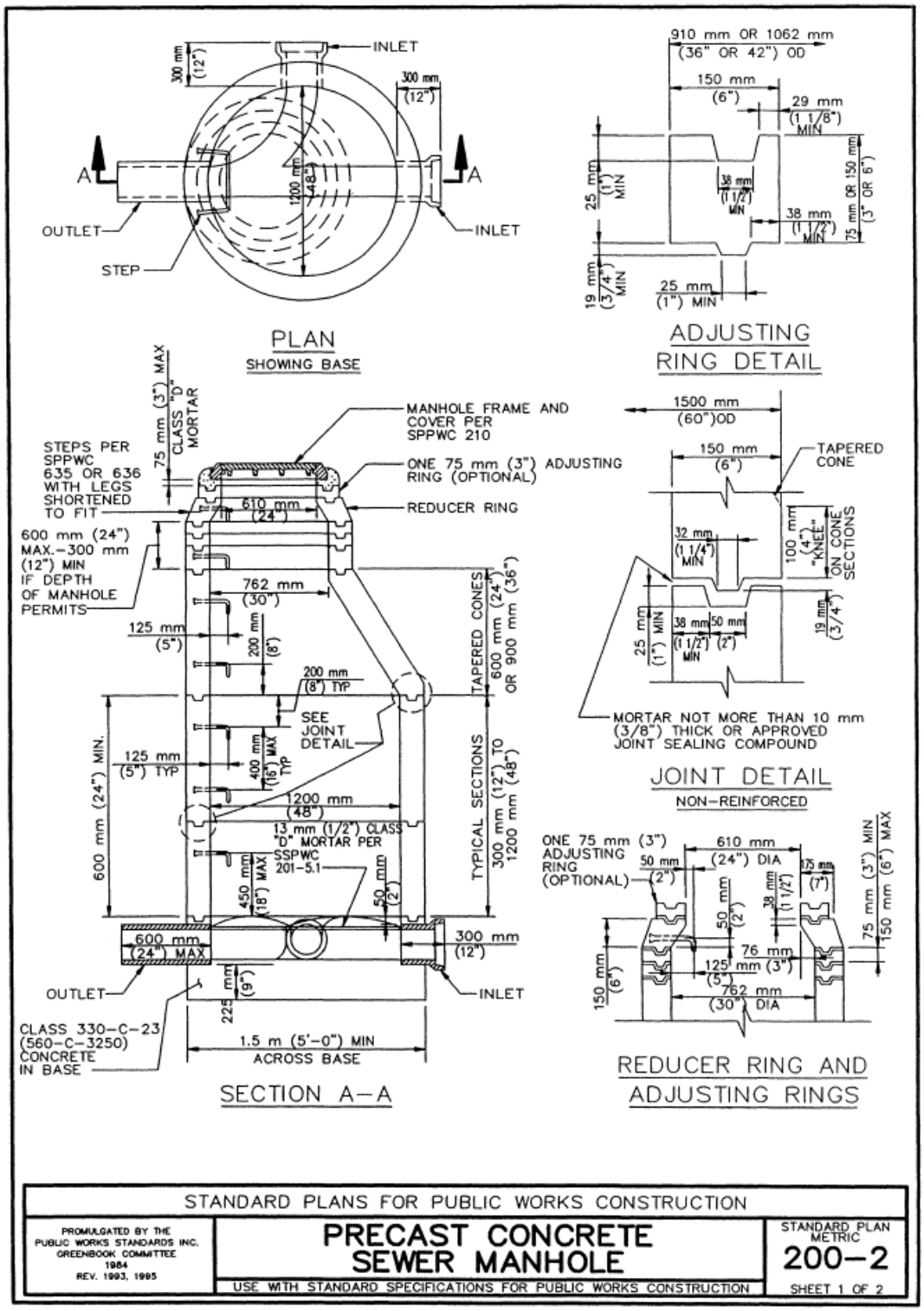
C. EXECUTION
   1. Earthwork. Backfill material for site utilities below paved areas (streets, parking lots, walkways) Sand shall be 12 inch above pipe then backfilled with 1.5 sack cement slurry up to sub-grade elevation. In planting areas, Sand shall be 12 inch above pipe, then backfilled with compacted native soil to finished grade.

   2. Piping Application.
      a. For gravity pipe sizes 4-inches thru 12-inches, the campus standard is Heavy Wall PVC SDR 26 ASTM D3034 pipe and fittings with Bell and Spigot gasket joints. The installation of the pipe and fittings shall be in strict accordance with the manufacturer's printed installation guide and instructions. Testing of pipe and fitting joints shall be in accordance to ASTM D3212.

   3. Piping Installation.
      a. Dead leg branches on waste lines shall be cut back as close as possible to the mains.
      b. Sanitary Drain PVC pipe shall be specified with an approved buried label tape and metal tracer wire.
      c. Cleanout & manhole cover shall be marked with letter 'S' for sewer

   4. Field Quality Control.
      a. The Contractor shall be required to video tape all new sanitary sewers, storm drains and manholes at the end of the project. Taping shall be done in the presence of the University Representative and a copy of the video given to the University as part of the record drawing requirement.

3.5 For Sewer Manhole use :



NOTES:

1. EXCEPT AS NOTED HEREON, THE PRECAST UNITS SHALL BE MANUFACTURED AND TESTED IN ACCORDANCE WITH ASTM C 478. AS AN ALTERNATE CURING METHOD, THE UNITS MAY BE CURED USING SATURATED STEAM FOR A MINIMUM OF 12 HOURS FOLLOWED BY 6 DAYS OF WATER CURING OR MEMBRANE CURING. IF THE UNITS ARE CURED BY THE ALTERNATE METHOD, THEY SHALL NOT BE SHIPPED PRIOR TO 8 DAYS AFTER CASTING NOR UNTIL THE CONCRETE HAS ATTAINED A STRENGTH OF 25 MPa (3500 PSI)

2. MANHOLE STEPS SHALL CONFORM TO SPPWC 635 TYPE 1 OR 3 OR SPPWC 636. THE MANHOLE STEPS SHALL BE UNIFORMLY SPACED AT A MAXIMUM OF 400 mm (16"). THE LOWEST STEP SHALL BE PLACED NOT LESS THAN 200 mm (8") NOR MORE THAN 450 mm (18") ABOVE THE SHELF. THE STEPS SHALL PROJECT 125 mm (5") INSIDE THE MANHOLE.

3. RISER SECTIONS MAY BE REINFORCED OR UNREINFORCED. REINFORCED SECTIONS SHALL BE REINFORCED IN ACCORDANCE WITH ASTM C 478 AND SHALL HAVE A MINIMUM WALL THICKNESS OF 125 mm (5"). UNREINFORCED RISER SECTIONS SHALL HAVE A MINIMUM WALL THICKNESS OF 150 mm (6").

4. THE 600 mm x 1200 mm (24"x48") ECCENTRIC CONES MAY BE REINFORCED OR UNREINFORCED. IF REINFORCED, THE WALL THICKNESS SHALL BE NOT LESS THAN 125 mm (5"). IF UNREINFORCED, THE WALL THICKNESS SHALL NOT BE LESS THAN 150 mm (6").

5. JOINTS SHALL BE TONGUE AND GROOVE. JOINTS FOR REINFORCED STRUCTURES SHALL CONFORM WITH ASTM C 478 SECTION 14.

6. PRECAST UNITS SHALL BE ASSEMBLED USING CLASS "B" MORTAR.

7. IF 762 mm (30") DIAMETER MANHOLE FRAME AND COVER IS REQUIRED, IT SHALL BE INSTALLED WHERE THE REDUCER RING IS SHOWN IN THE SECTION.

8. FOR REINFORCED PRECAST STRUCTURES, ALL REINFORCEMENT SHALL HAVE A MINIMUM OF 50 mm (2") OF COVER OVER THE STEEL ON THE INSIDE FACE.

9. THE TOP OPENING OF THE MANHOLE AND THE STEPS SHALL BE PLACED DIRECTLY OVER THE OUTLET OF THE STRUCTURE EXCEPT AS OTHERWISE NOTED ON PLANS.

10. CONCRETE BASE AND STUB WALLS SHALL BE POURED IN ONE OPERATION TO A POINT 50 mm (2") ABOVE THE INLET AND OUTLET PIPES. ALL PIPES SHALL BE RIGIDLY SUPPORTED BY TEMPORARY PIERS OR OTHER METHODS DURING THE OPERATION. CONCRETE SHALL SET FOR 24 HOURS BEFORE PLACING PRECAST UNITS.

STANDARD PLANS FOR PUBLIC WORKS CONSTRUCTION	STANDARD PLAN METRIC 200–2 SHEET 2 OF 2
PRECAST CONCRETE SEWER MANHOLE	

334000 STORM DRAINAGE UTILITIES

A. GENERAL REQUIREMENTS – NOT USED

B. PRODUCTS – NOT USED

C. EXECUTION
1. Earthwork. Backfill material for site utilities below paved areas (streets, parking lots, walkways) Sand shall be 12 inch above pipe then backfilled with 1.5 sack cement slurry up to sub-grade elevation. In planting areas, Sand shall be 12 inch above pipe, then backfilled with compacted native soil to finished grade.

2. Piping Application.
   a. For gravity pipe sizes 4-inches thru 12-inches, the campus standard is Heavy Wall PVC SDR 26 ASTM D3034 pipe and fittings with Bell and Spigot gasket joints. The installation of the pipe and fittings shall be in strict accordance with the manufacturer's printed installation guide and instructions. Testing of pipe and fitting joints shall be in accordance to ASTM D3212.

3. Piping Installation.
   a. Storm Drain PVC pipe shall be specified with an approved buried label tape and metal tracer wire.
   b. Cleanout & manhole cover shall be marked with letter 'D' for storm drain.

4. Field Quality Control.
   a. The Contractor shall be required to video tape all new sanitary sewers, storm drains and manholes at the end of the project. Taping shall be done in the presence of the University Representative and a copy of the video given to the University as part of the record drawing requirement.

335000 NATURAL GAS UTILITIES

A. Piping below grade shall be schedule 40 ASTM A-53 steel with welded fittings and joints.
B. Underground steel piping buried directly in the soil shall be Factory applied epoxy coated.
C. Field made joints shall be wrapped with two layers half-lapped of 20 mil PVC tape to a total thickness of 40 mils. Tape shall be applied only after the complete joint is heated to ensure a complete bonding of the tape to the pipe. A finish coat of approved bitumastic shall be applied.
D. Field wrapping of pipe is not acceptable.
E. Require a holiday test for all underground wrapped pipes. Test to be witnessed by the University's Representative.

336000 HYDRONIC UTILITIES

A. GENERAL REQUIREMENTS

1. Building chilled water and heating hot water lines shall be metered. When building steam line is provided with meter then heating hot water line shall not be metered. Meters shall be shall be ultrasonic type, Flexim ADM7407 or equal. Indicate size of meter, maximum and minimum flow, and pressure and temperature sensors on mechanical drawings. Meters shall be sized so minimum flow (or 10% of maximum flow, whichever is lower) is within its range. Meters shall be connected to BAS.
2. Provide dielectric flanges on supply and return lines at the entrance to the building to isolate from buried utility lines.

B. PRODUCTS

1. Pre-insulated Piping System.
   a. Factory pre-fabricated and pre-insulated piping system as fabricated by following manufacturers or equal.
      - Perma-Pipe/Ric Wil, Xtru Therm Gold
      - Rovanco HDPE Jacketed Pipe System with epoxy coated steel pipe
   b. All straight sections shall be factory pre-insulated and jacketed. Design and manufacture shall be per ANSI B31.1 latest edition.
   c. Service pipe shall be Standard Weight, ASTM A53, Grade B, seamless, carbon steel. All joints shall be butt-welded for sizes 2-1/2" and greater, and socket welded for 2" and below. The exterior of steel pipes and fittings surface shall be abrasive blast-cleaned to a minimum of a near white surface, profile a minimum of 1.5 mil peak to valley range. After blasting, the steel service pipes and fittings shall be coated with epoxy to a minimum thickness of 8-12 mil. Coated fittings and pipes shall be factory holiday tested at 1000 volts to ensure a void free coating. Certified test reports shall be submitted to the University's Representative.
   d. Service pipe insulation shall be polyurethane foam 2" thick and 2 pcf density. The insulation shall completely fill the annular space between the service pipe and the jacket.
   e. The outer protective insulation jacket shall be high density polyethylene (HDPE) in accordance with ASTM D1248, Type 3, and Class C, Minimum thickness of 0.08". End seals shall be factory installed on all exposed insulation on pipe prior to shipment.
   f. All fittings (elbows, tees, reducers, anchors, etc.) shall be factory pre-fabricated and pre-insulated. Straight tangent lengths shall be factory welded to all ends so that all field joints are at the straight section of pipes. Field insulation of fittings is not acceptable.

2. Dielectric Flange Kit. Flange isolation kit complete with neoprene-faced phenolic full-faced gasket, double phenolic washers, double steel washers, and phenolic sleeves, ANSI rated 150 psi, 100°F maximum temperature.

3. Valves – Not Used

C. EXECUTION

1. Earthwork. Backfill material for site utilities below paved areas (streets, parking lots, walkways) shall be 1.5 sack cement slurry, up to the underside of the finished pavement.

In planting areas, 1.5 sack cement slurry shall be up to 12 inches top of pipe, then backfilled with 90% compacted native soil to finished grade.

2. Piping Application – Not Used

3. Piping Installation
   a. Slope all piping to allow venting and draining to building or vault. If this is not possible due to job condition, provide vents in concrete boxes on grade. Concrete box locations shall be approved by the University's Representative.
   b. No pipe shall be encased, embedded or cast into the building's concrete footings, floor slabs, walls or other structure. Taping and/or foam wrapping of pipe and fittings does not constitute a code or University approved method of separation.
   c. All below grade piping systems shall be identified with acid and alkali resistant polyethylene warning tape 6 inch wide 4 mils thick. Tape shall indicate the name of the utility system. Tape for plastic piping shall have approved tracer wire. Tape shall be installed 12 inches above piping.

4. Field Quality Control
   a. Require a certification by the manufacturer that the installation is in conformance with the manufacturer recommendations.
   b. Hydrostatically field test pipe to 150 psig or 1.5 times the design pressures whichever is greater before insulating the field joints. All insulation and jacketing material for field joints shall be furnished by the system manufacturer.

336300 STEAM UTILITIES

A. GENERAL REQUIREMENTS
   1. Direct buried factory pre-fabricated and pre-insulated piping system. Piping and insulation shall be designed for 125 psig and 400°F however size expansion for 490°F superheated steam.
   2. Building steam line shall be metered. Meter shall be vortex shedding type, Foxboro 84F or equal. Indicate size of meter, maximum and minimum flow, and pressure and temperature sensors on mechanical drawings. Meters shall be sized so minimum flow (or 10% of maximum flow, whichever is lower) is within its range. Meter shall be connected to BAS.
   3. Provide dielectric flanges on steam and condensate return lines at the entrance to the building to isolate from buried utility lines.

B. PRODUCTS
   1. Pre-insulated Piping System.
      a. Factory pre-fabricated and pre-insulated piping system as fabricated by following manufacturers or equal.
         - Perma-Pipe, Multi-Therm 500 Gold
         - Rovanco Insul 800 with epoxy coated outer conduit
      b. Carrier Pipe:
         - Steam Piping: Steel pipe ASTM A53 Grade B, seamless, Standard Weight, black with butt weld ends.
         - Steam Fittings: Std. weight carbon steel, butt weld, ASTM A234, Class 300 with butt welded joints per AWS D1.1.
         - Condensate Pipe: Extra heavy carbon steel pipe, ASTM A53 Grade B, seamless, black with butt weld ends.

- Condensate Fittings: Extra heavy weight carbon steel, butt weld, ASTM A234, Class 300 with butt weld joints per AWS D1.1.
- Insulation: Factory installed mineral wool on pipes and fittings.

c. Conduit: 10-gauge steel welded casing for conduit up to 26" in diameter, 6-gauge for 28" – 36". Size conduit to accommodate the insulated carrier pipe and a 1-inch air space between the mineral wool and the interior of the conduit.
d. Insulation: Factory installed polyurethane 2 lb/cu. ft. 1" thick.
e. Outer Jacket: Factory installed high density polyethylene with a minimum thickness of 0.100 inch.
f. Steel carrier pipe and conduit exterior shall be abrasive blast clean to a minimum of a near white surface, SSPC-SP10-63T. Apply epoxy coating to a thickness of 8-12 mil. Coated pipes, fittings and conduit shall be factory holiday tested at 1000 volts to ensure a void free coating.

C. EXECUTION

1. Earthwork. Backfill material for site utilities below paved areas (streets, parking lots, walkways) shall be 1.5 sack cement slurry, up to the underside of the finished pavement. In planting areas, 1.5 sack cement slurry shall be up to 12 inches top of pipe, then backfilled with 90% compacted native soil to finished grade.

2. Piping Application – Not Used

3. Piping Installation
   a. Slope all piping to allow venting and draining to building or vault. If this is not possible due to job condition, provide vents in concrete boxes on grade. Concrete box locations shall be approved by the University's Representative.
   b. No pipe shall be encased, embedded or cast into the building's concrete footings, floor slabs, walls or other structure. Taping and/or foam wrapping of pipe and fittings does not constitute a code or University approved method of separation.
   c. All below grade piping systems shall be identified with acid and alkali resistant polyethylene warning tape 6 inch wide 4 mils thick. Tape shall indicate the name of the utility system. Tape for plastic piping shall have approved tracer wire. Tape shall be installed 12 inches above piping.

4. Field Quality Control
   a. Require a certification by the manufacturer that the installation is in conformance with the manufacturer recommendations.
   b. Hydrostatically field test pipe to 150 psig or 1.5 times the design pressures whichever is greater before insulating the field joints. All insulation and jacketing material for field joints shall be furnished by the system manufacturer.

PART-1: UTILITY METERING

A. All new buildings and renovation projects shall include installation of University approved permanent metering of all utilities. Utilities include electricity, domestic water, chilled water, steam, natural gas, compressed air and irrigation water.
B. Utility meters shall be designed and specified by the project Design Professional. Project contractor shall furnish and install all utility meters. Utility meter commissioning phase shall be a joint effort between the project contractor, Design Professional, Capital Programs CxA

and Facilities Management energy service. The University will not accept any utility meter until it has been shown to be fully functioning and operates per manufacturers guide specifications

C. Review the proposed metering scope with a representative from the FM - Energy Services Department early at the Basis of Design phase of the project to confirm that the campus metering requirements are being followed.
D. Proposed meter locations and the specific type of meter shall be reviewed and approved by the FM - Energy Services Department.
E. All utilities consumed during construction shall be metered. FM - Energy Services will provide the project with temporary utility meters. Capital Programs shall be billed for consumption, unless specifically stated otherwise in writing.
F. Contractor shall provide a minimum 2 weeks' notice per each utility prior to the Temporary Utility Meter installation and connection (HHW, Electrical, CHW). Domestic Water, Natural Gas and Steam cannot be temporarily installed. Contractor shall be responsible for the permanent installation and commissioning of the domestic water, natural gas, and steam metering systems prior to requesting service.
G. All meter installations shall be installed on the interior of the building (i.e. mechanical or electrical rooms) near the utility-service entrance. In situations where the local utility company is providing the meter installation, and/or meters are installed exterior to the building, a pathway will be required for communication wiring to enter the mechanical/electrical room to the metering panel.
H. All meter installations shall meet all the requirements of the manufacturer.
I. Metering is to include provisions of all required interconnections wiring, metering accessories (i.e. split-core current transducers, temperature transducers, etc…) 120VAC power supply, connections, data communications wiring and Ethernet data connections.
J. Quality Assurance: Test system to verify that all metered values recorded into the campus metering system match locally-verified utilizing portable testing equipment for chilled water, hot water-heating systems and gas systems.
K. The metering system Utility Metering Panel(s) shall be connected to the Facilities Management Building Communication Panel.

A. SCOPE OF WORK

1. Furnish and install a fully integrated Utility Metering System, incorporating metering data, data transmission and subsystems as herein specified.
2. All materials and equipment shall be standard components, regularity manufactured for this and/or other systems and not custom designed specifically for this project. All system components shall have been thoroughly tested and proven in actual use for at least two years in the U.S. commercial or industrial controls industry.
3. Provide all communication and instrumentation wiring for a complete and operable system. All wiring shall be installed in accordance with the California Electrical Codes.

B. WORK BY OTHERS

1. Division 23 Mechanical Contractor shall install
   a. Thermowells
   b. In-line flow meters
   c. Pressure taps.

2. Division 26 Electrical Contractor shall provide:
   d. 120V AC power junction boxes for all Utility Metering Panels.
   e. Network cabling (Cat6, shielded twisted pair) between meters and utility metering panels

3. University Representative shall provide programming to the utility metering panel's gateways.

C. SUBMITTALS

1. Submit five (5) complete sets of documentation for designed system approval:
   a. Equipment data specification cut sheets
   b. System schematic diagrams and bill of material
   c. Utility Metering Panel layout drawings with field terminal strips, meter instrument wiring, inter-panel wiring, and power supplies.
   d. System riser diagram with interface to Facilities Management - Building Communication Panel.
2. Upon project completion, submit operation manuals consisting of the following:
   a. Index sheet, listing contents in order.
   b. Manufacturer's equipment parts lists of all functional components of the system.
   c. Floor Plan drawings showing locations of all metering panels, electrical and flow meters along with their associated sensors (pressure, temperature).
   d. Auto-CAD disk of as-built system schematics including all wiring diagrams.

D. WARRANTY

1. Provide all services, installation, materials and equipment necessary for the successful operation of the entire utility metering system for a period of two (2) years after University formal acceptance.
2. The adjustment, required testing, and repair of the system shall include all electronic equipment, network and communication equipment and all instrumentation/sensor devices.
3. Coordinate with Facilities Management a system inspection 10 months after beneficial use or 2 months prior to expiration to correct all deficiencies discovered by the University during normal occupied building operation.
4. On-site service shall be within 24 hours or the next business day.

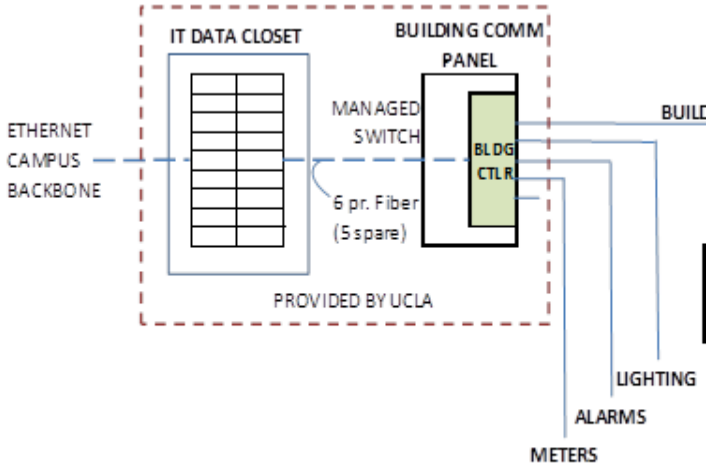
PART-2: PRODUCT - UTILITY METERING PANEL (UMP)

A. SUMMARY:

1. **All UMP's vary with size, design, scope and complexity of the project. The correct panel configuration will require a review of the project scope by a representative of FM - Energy Services Department**. **See Detail: 3.8 Typical Utility Metering Panel Layout in Part 3 – Execution**
2. Prior to any commodity being energized or supplied to the project, the metering must be in place, setup and logging correct consumption data. All metered connections and setup configuration must be approved and documented by an FM-Energy Services representative.
3. A meeting between the BAS contractor, Capital Programs, and Facilities Management – Energy Services group will be held as early as possible, prior to purchase of any material, to review the installation, integration and finalize panel and wiring locations.
4. The Contractor is responsible for integration to the UMP and will not receive final payment for the project until the metering system is fully integrated and accepted by Facilities Management – Energy Services Department.

B. POWER: will require a dedicated 120 VAC, 20amp, single phase electric circuit source.

C. WIRING: The project shall provide an Ethernet patch cable from the UMP to the Facilities Management's - Building Communication Panel (BCP).



D. COMMUNICATION PROTOCOL:

1. Modbus TCP (preferred)
2. TCP/IP
3. If the output of the meter, does not communicate via Modbus TCP or TCP/IP then a converter box must be installed in the panel to read those signals.

E. ENCLOSURE:

4. SIZE: 30" x 24" nominal, NEMA 1, steel by Hoffman or equal
5. BOX-LID: 30" x 24" nominal, NEMA 1, steel, by Hoffman or equal
6. LOCK: Lock Kit, Type 1, steel, by Hoffman or equal

F. POWER OUTLET: Dual 120 VAC, 15A, Power Receptacle, DIN rail

G. POWER SUPPLY: AC-DC, Enclosed, 24VDC, 0.5A, DIN rail, by Phoenix Contact 2868648 or equal

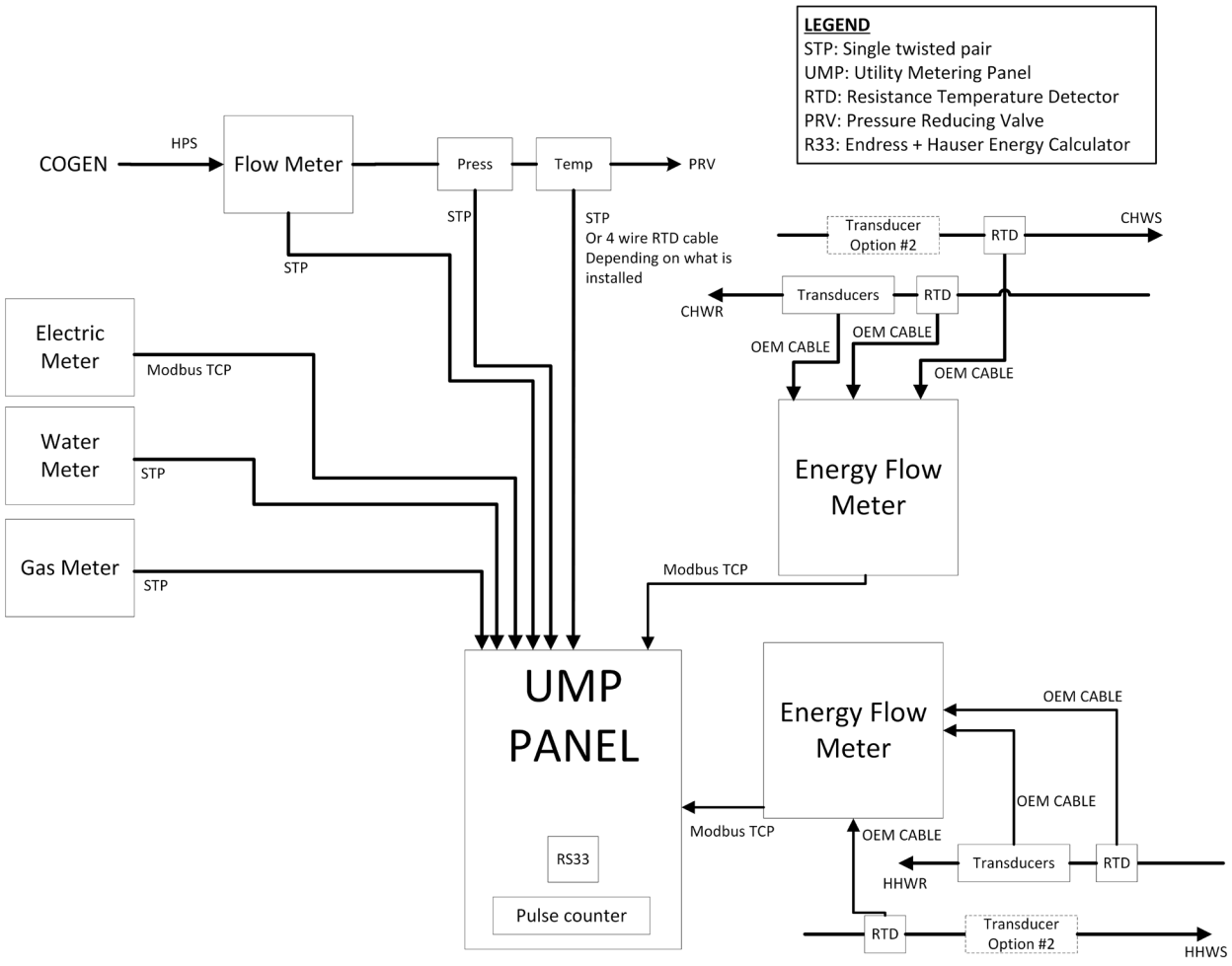
H. GATEWAY: Ethernet, Sybus, RS485, RS232, 10/100 Base TX, DIN rail, by Schnieder Elec. EGX100SD or equal

I. GATEWAY: IoT Embedded, DIN rail, by Advantech ARK-1122F-S8A1E

J. SWITCH: Ethernet, High Temp, 5-port, DIN rail, by Starcom

K. ANALOG MODULE: Ethernet to analog out module, DIN rail, by Acromag 972EN-4006 or equal

L. Terminal blocks, fuses, etc. as needed.



ELECTRICAL METERING

A. SUMMARY

1. **All electrical metering requirements vary with size, design, scope and complexity of the project. The correct meter configuration will require a review of the project scope by a representative of FM - Energy Services Department.**
2. The electrical contractor will furnish and install all components but not limited to all conduits, wire, current transformers, voltage transformers, fuse blocks and fuses, shorting blocks, Ethernet gateways, communication wiring between meters, remote displays and all utility metering panels.
3. Incoming electrical power for new building construction and for major system renovations to existing building's where metering is not already installed.
4. Sub metering of major building systems, or of selected spaces within the building, may be required for LEED certification or by specific building program requirements or for sub metering of tenants that have been rechargeable by the campus within the building.
5. The electrical contractor shall provide electric meters of the type and capabilities required to meter all electrical power serving the building or renovation.

6. All electric meters to be installed, calibrated and adjusted by trained instrument technicians. The electrical contractor will be responsible for all work performed by their subcontractors.
7. Submit engineering/wiring drawings and receive approval prior to beginning work. These drawings shall be submitted in a timely manner to provide sufficient time to review drawings so as not to hold up the project.
8. All active Ethernet switches, hubs required for the communication between the electrical meters and the UMP's shall be provided and installed by the contractor.
9. The conduit and wiring system required for electrical metering shall be complete, separate and independent system. Conduit sharing with other unrelated electrical systems is not permitted.

B. ELECTRICAL METER - shall be equal or better to the specifications below:

1. MEASURING POINTS:
   a. Real Power (kW), three phase total
   b. Real Energy (kWh), three phase total
   c. Current (A), per phase and three phase total
   d. Voltage (V), per phase, three phase total, phase to phase, phase to neutral
   e. Reactive Power (kVAR), three phase total
   f. Apparent Power (kVA), three phase total
   g. Power Factor, per phase & three-phase total
   h. Power Demand (kW), three phase total, present and peak

2. ACCURACY: 0.2% accuracy class per ANSI C12.20. ANSI C12.1 and C12 Standards apply.

3. VOLTAGE RANGE: 120 to 480 VAC

4. DISPLAY: Backlit LCD

C. CURRENT TRANSFORMERS (CT's):
   1. Accuracy: Shall be 0.3% Class

D. POTENTIAL TRANSFORMERS: (PT's):
   1. Shall be 0.3% Accuracy Class

E. COMMUNICATIONS:
   1. Modbus TCP/IP

CHILLED WATER METERING

A. SUMMARY:
1. Chilled water flow meter with energy calculation functionality shall be installed for all new building construction, and for mechanical systems renovations of existing buildings that are located on the main campus and have connections to the campus district heating/cooling system.
2. A pressure/temperature test port ("Pete's Plug") shall be installed adjacent to each temperature transmitter, to allow for calibration.
3. All active Ethernet switches and hubs required for the communication between the chilled water flow and BTU totalizing meters, differential temperature sensors and the UMP's shall be provided and installed by the contractor.

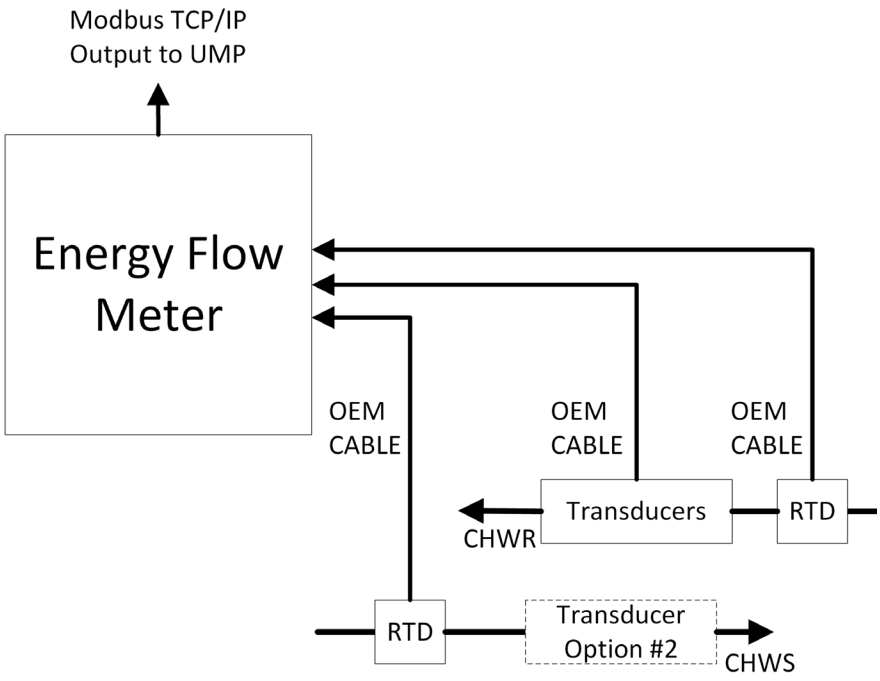
B. FLOW COMPUTER:
1. Acceptable Manufactures:
   a. Flexim 7407
   b. Siemens 1010 FU[S or E]
   c. Approved Equal, as determined by the FM - Energy Services Department
2. MEASURING POINTS: in a non-volatile memory storage;
   a. Energy - ton-hrs or btus
   b. Demand rate (tons or btus/hr),
   c. Volumetric flow - GPM
   d. Totalized (ton-hrs or btus), gallons
   e. Temperature – Degrees F
   f. Flow - GPM
3. ACCURACY: Minimum of +/- 1% of the reading, over a flow range of 1 to 30 feet per second.
4. TYPE: Ultrasonic-type, single and dual channel
5. DISPLAY: minimum 40 characters, 2 line alphanumeric, backlit LCD
6. COMMUNICATIONS:
   a. Output: Modbus TCP/IP
7. Surface contact sensors and conductive coupling grease shall be suitable for the temperature rating of the process being measured; sensors shall be designed to minimize/eliminate the need for preventive maintenance of the coupling grease.
8. STANDARDS: Meter must operate and measure energy in accordance with EN 1434-1.

C. TEMPERATURE SENSORS
1. Acceptable Manufactures:
   a. Minco - Model S479
   b. Approved equal by FM - Energy Services Department
2. CALIBRATION: Factory calibrated matched sets
3. ACCURACY: IEC 60751, Class A
4. TYPE: RTD using a Pt1000 or Pt 100 (Either Insertion or strap-on)
5. TEMPERATURE RANGE: 40 to 70 F
6. RESPONSE TIME: minimum of 250 mS
7. OUTPUT: 4 to 20 mA, linearly proportional to temperature

8. Sensors shall be suitable for the temperature rating of the process being measured; sensors shall be designed to minimize/eliminate the need for preventive maintenance of the couplant compound.
9. Provide a conduit box for field wiring terminations

D. THERMOWELLS
1. STANDARD: ASME B40.200
2. CASING: Brass
3. LENGTH: As needed to fit temperature sensor length required for tip of probe to be in center of piping
4. TAPER: Straight shank unless stepped or tapered shank is indicated.
5. PRESSURE RATING: Not less than the system design pressure
6. Threaded Cap Nut, with chain permanently fastened to well and cap.
7. Thermal paste shall be used and should be suitable for the temperature rating of the process being measured.

E. BTU TOTALIZING METER
1. Acceptable Manufactures
   a. Endress Hauser – RH33
   b. Approved equal as determined by FM - Energy Services Department.
2. INPUTS: minimum 2 Current/RTD and 1Current/pulse and 2 digital
3. OUTPUTS: Ethernet/ TCP/IP or Modbus TCP
4. STANDARDS: EN1434 and IAWPS-IF97
5. BTU meter shall be approved for “Custody Transfer” as defined by EN1434
6. MEASURING POINTS, stored in non-volatile memory
   a. Volume
   b. Density
   c. Enthalpy and Differential Enthalpy
   d. DP Plow compensation
   e. Mass
   f. Temperature Differential
7. ENCLOSURE: NEMA 4x



STEAM METERING

A. SUMMARY:
   1. Provide for new building construction, and for mechanical system renovations of existing buildings that are located on the main campus.
   2. All active Ethernet switches, hubs required for the communication between the chilled water flow and BTU totalizing meters, temperature sensor, pressure sensor and the UMP's shall be provided and installed by the contractor.

B. FLOW METER - shall be equal/better to the specifications below:
   1. Acceptable Manufactures
      a. Siemens - Sitrans FX300 Vortex Flow Meter
      b. Sierra Instruments – InnovaMass 240S Inline
      c. Approved equal by Energy Services
   2. Shall be calibrated to each other and shall be flow-calibrated and assigned a calibration factor at the factory. The calibration factor is entered into the transmitter, enabling interchangeability of sensors without calculations or a compromise in standard accuracy.
   3. ACCURACY: Minimum of 1.5 % of reading for volumetric flow
   4. OUTPUT: Current (4-20 mA) or Pulse (scaled) for total flow
   5. TYPE: Vortex Shedding
   6. DISPLAY: Minimum 2 line, backlit LCD
   7. DISPLAY OPTION: Meter shall have a remote display option.

C. BTU TOTALIZING METER - shall be equal/better to the specifications below:
   1. Acceptable Manufactures:
      a. Endress Hauser – RS33
      b. approved equal as determined by Energy Services.
   2. INPUTS:
      a. minimum of 2 Current/RTD

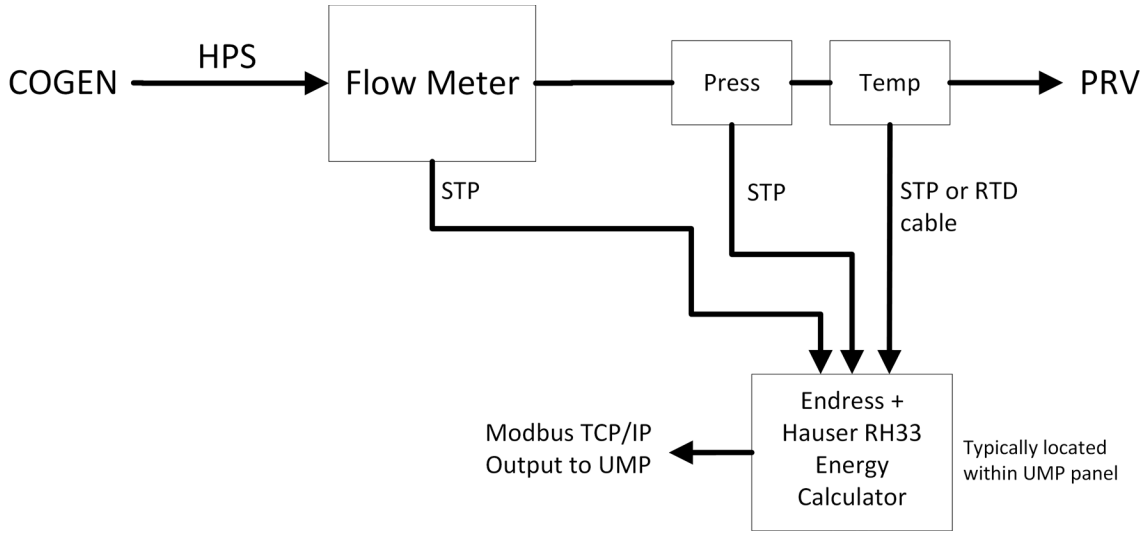
b. 1 Current/pulse
c. 2 digital

3. OUTPUTS:
   a. Ethernet/ TCP/IP
   b. Modbus TCP
4. STANDARDS: IAWPS-IF97
5. MEASURING POINTS, stored in non-volatile memory:
   a. Volume
   b. Density
   c. Enthalpy
   d. DP Plow compensation
   e. Mass
6. ENCLOSURE: NEMA 4x
7. BTU meter shall be approved for “Custody Transfer”

D. TEMPERATURE SENSOR - shall be equal/better to the specifications below:
   1. Acceptable manufactures
      a. Minco - Model S479
      b. Approved equal by FM - Energy Services Department
   2. TYPE: RTD using a Pt1000 or Pt 100
   3. PROCESS RANGE: 200 to 700 F
   4. ACCURACY: IEC 60751, Class A
   5. TYPE: RTD using a Pt1000 or Pt 100
   6. RESPONSE TIME: 250ms
   7. LENGTH: In accordance with ISA Standards
   8. OUTPUT: 4-20mA, linearly proportional to flow

E. THERMOWELL - shall be equal/better to the specifications below:
   1. CASING: Stainless steel
   2. LENGTH: As needed to fit temperature sensor length required for tip of probe to be in center of piping.
   3. TAPER: Straight shank unless stepped or tapered shank is indicated.

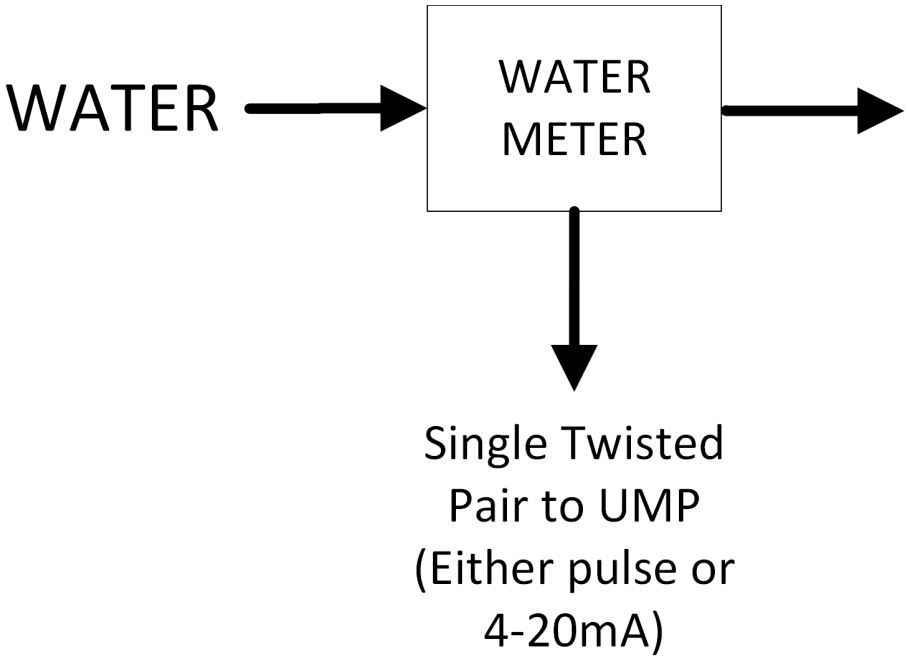
F. PRESSURE SENSOR - shall be equal/better to the specifications below:
   1. CASING: Stainless Steel
   2. ACCURACY: +/- 0.25% over the span
   3. SCALE: Should be selected to provide a reading at mid-scale during normal operation.
   4. CLASS: ANSI 150
   5. OUTPUT: 4 – 20 mA, linearly proportional to flow
   6. Shall include a shut-off SST ball valve (gauge cocks not permitted)
   7. Shall include a pigtail cooling loop



DOMESTIC WATER METERING

A. Summary:
   1. Water supply to buildings shall be metered for all new buildings and major additions and renovations.
   2. Shall be non-magnetic and designed for water containing debris. Materials that are wetted shall be made from non-corrosive materials and shall not contaminate water.
   3. The flow meter shall be provided with particulate strainer, isolation valves and bypass line to be rate for installation in pipes of ¾ to 10 inches in diameter.
   4. Meter(s) installed on the high side of the pressure regulating station shall be capable of maximum operating pressures to 200 psi.
   5. No battery powered registers (including remote registers) are permitted.
   6. Easy access shall be provided to meters for maintenance, repairs and meters shall be circular flanged (>=2inch diameter) and valved to permit convenient replacement of metering.
   7. Water meter must be cable of outputting via either 4-20mA or pulses.

B. Flow Meter - shall be equal/better to the specifications below:
   1. Manufacturer for low side of pressure regulating station shall be;
      a. Neptune Tru/Flo Compound Meter
      b. Sensus Omni Compound (C^2) Meter
      c. Or equal
   2. Manufacturer for the high-side of the pressure regulating station shall be;
      a. Sensus Omni Turbine (T^2) or Compound (C^2) Meter
      b. Or equal
   3. ACCURACY: +/- 1.5% of reading over the full range
   4. STANDARD: AWWA C702 complaint
   5. TRANSMITTER: Shall provide a pulse or 4-20mA output.
   6. DISPLAY UNITS: Cubic Feet
   7. CONNECTIONS:
      a. Piping diameter 2 inches and greater – Round Flanges AWWA 125 Pound Class
      b. Piping diameter less than 2 inches – Unions



NATURAL GAS METERING

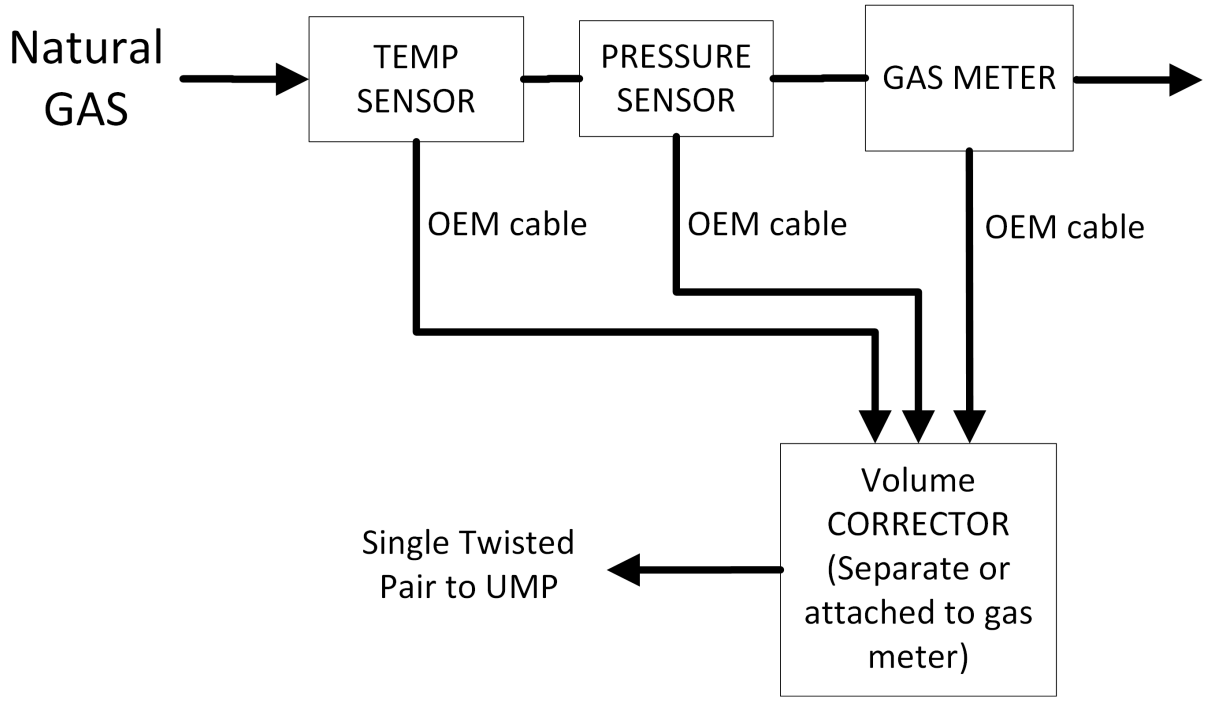
A. Summary:
   1. Gas supply to buildings shall be metered for new buildings and major additions and renovations. Meters shall be temperature and pressure compensated when installed upstream of the building pressure regulator.
   2. No battery powered registers, including remote registers, are permitted. Backup battery power is acceptable.

B. Flow Meter:
   1. Manufacturers:
      a. Dresser, Roots Meter (>= 800 CF/hr)
      b. Esler American (< 800 CF/hr)
      c. Or equal
   2. STANDARDS: ANSI/ASC-B109.3 and ASME B31.8
   3. DISPLAY UNITS: Hundred cubic feet (CCF)
   4. RESOLUTION: Minimum of 1 CCF
   5. ACCURACY: Shall be plus or minus 0.5% of full scale or plus or minus 1% of reading.
   6. REPEATABILITY: Shall be plus or minus 0.2%
   7. VOLUME CORRECTOR: Meter must include a volume corrector with both a pressure and temperature sensor. Volume corrector may be either attached to the meter directly or remotely placed when direct access is not feasible. All cables and software needed to interface with the volume corrector must be included.
   8. OUTPUTS: Volume corrector must include the ability to output pulse signals.

C. Must include a dedicated pressure regulating valve installed upstream of the meter.
D. Remote volume corrector shall be provided when the meter location prevents direct reading of the meter from a standing position on grade or finished floor. Remote volume corrector

shall be installed at 4 feet to 5 feet above grade or finished floor. Remote volume corrector shall be compatible with the installed meter and shall have a digital display.

E. The UMP accepts Modbus TCP communications. This may require the UMP to be fitted with a pulse to Modbus TCP communication card that is DIN rail mounted.
F. A/E shall provide detailed wiring diagrams in the contract drawings for both meter power and communication connections.
G. Easy access shall be provided to meters for maintenance, repairs and meters shall be circular flanged and valved to permit convenient replacement of metering.



PART-3: EXECUTION

A. All meter installations shall be installed on the interior of the building (i.e. mechanical or electrical rooms), near the utility-service entrance. In situations where the local utility company is providing the meter installation, and/or meters are installed exterior to the building, a pathway will be required for communication wiring to enter the mechanical/electrical room to the metering panel.
B. Metering is to include provisions of all required interconnections wiring, metering accessories (i.e. split-core current transducers, temperature transducers, etc…) 120VAC power supply, connections, data communications wiring and Ethernet data connections.
C. Quality Assurance: Before the start of taking utilities from the campus, Contractor shall be required to prove that all utility meters (new or existing) are installed properly and function as designed and specified. For renovations where there are existing utilities, it will be necessary to recommission those meters as well. The utility meter commissioning shall be accomplished by the contractor in Conjunction with Capital Programs and a representative from FM - Energy Services Department. Proper functionality includes:
   1. Proper installation of the meter and associated sensors according to the manufacturer's installation recommendations in addition to all Applicable Code Requirement.
   2. Meter accuracy performing as-specified under all expected design flow conditions

3. Local flow display installed as-specified, reading in the specified engineering units
4. Required calibration data, O&M manuals, product specification sheets prior to the joint commissioning of the meter(s)

D. All stand-alone meter displays shall be mounted 3 to 5 feet above the finished floor.
E. Sensors to measure chilled water supply and return temperatures where the headers enter the building.
F. Install meters and their associated sensors in accessible positions in piping systems to allow for service and maintenance of the element.
G. Adjusting:
   1. After installation, calibrate meters according to manufacturer's written instructions.
   2. Adjust faces of meters and sensor displays to proper angle for best visibility.
H. Install all metering devices, flow computers and sensors according to manufacturer's recommendations
I. UMP shall be installed in within eye sight of the meter installation.
J. UMP location shall have a wifi signal of not less than 3 bars (RSSI -87 to -92)

UTILITY METERING PANEL (UMP)

A. Submit engineering/wiring drawings and receive approval prior to beginning work.
B. Top of meter panel shall be mounted 6 feet A.F.F.
C. All conduits shall enter electrical enclosures from the bottom.

ELECTRICAL METERING

A. All stand-alone meter displays shall be mounted 5 feet above the finished floor.
B. Install all metering devices, current and potential transformers according to manufacture recommendations.

CHILLED WATER METERING

A. Meter must be installed per the manufacturer's specifications and must be field verified by FM – Energy Services Department. Approval from the University must be obtained before material is purchased to ensure flow meter is within allowable flow ranges.
B. All stand-alone meter displays shall be mounted 5 feet above the finished floor.

STEAM METERING

A. Meter must be installed per the manufacturer's specifications and must be field verified by FM – Energy Services Department. Approval from the University must be obtained before material is purchased to ensure flow meter is within allowable flow ranges.

DOMESTIC WATER METERING

A. Meter must be installed per the manufacturer's specifications and must be field verified by FM – Energy Services Department. Approval from the University must be obtained before material is purchased to ensure flow meter is within allowable flow ranges.
B. Easy access shall be provided to meters for maintenance, repairs and meters shall be circular flanged and valved to permit convenient replacement of metering.
C. Design Professional shall design for Modbus TCP or RTU communications to give data back to the Utility Metering Panel (UMP). This may require the UMP to be fitted with a DIN rail, frequency to Modbus RTU slave device.

D. Remote registers shall be provided when the meter location prevents direct reading of the meter register from a standing position on grade or finished floor. Remote registers shall be installed at 4 feet to 5 feet above the grade of finished floor. Remote registers shall be compatible with the installed meter and shall have an odometer type display.

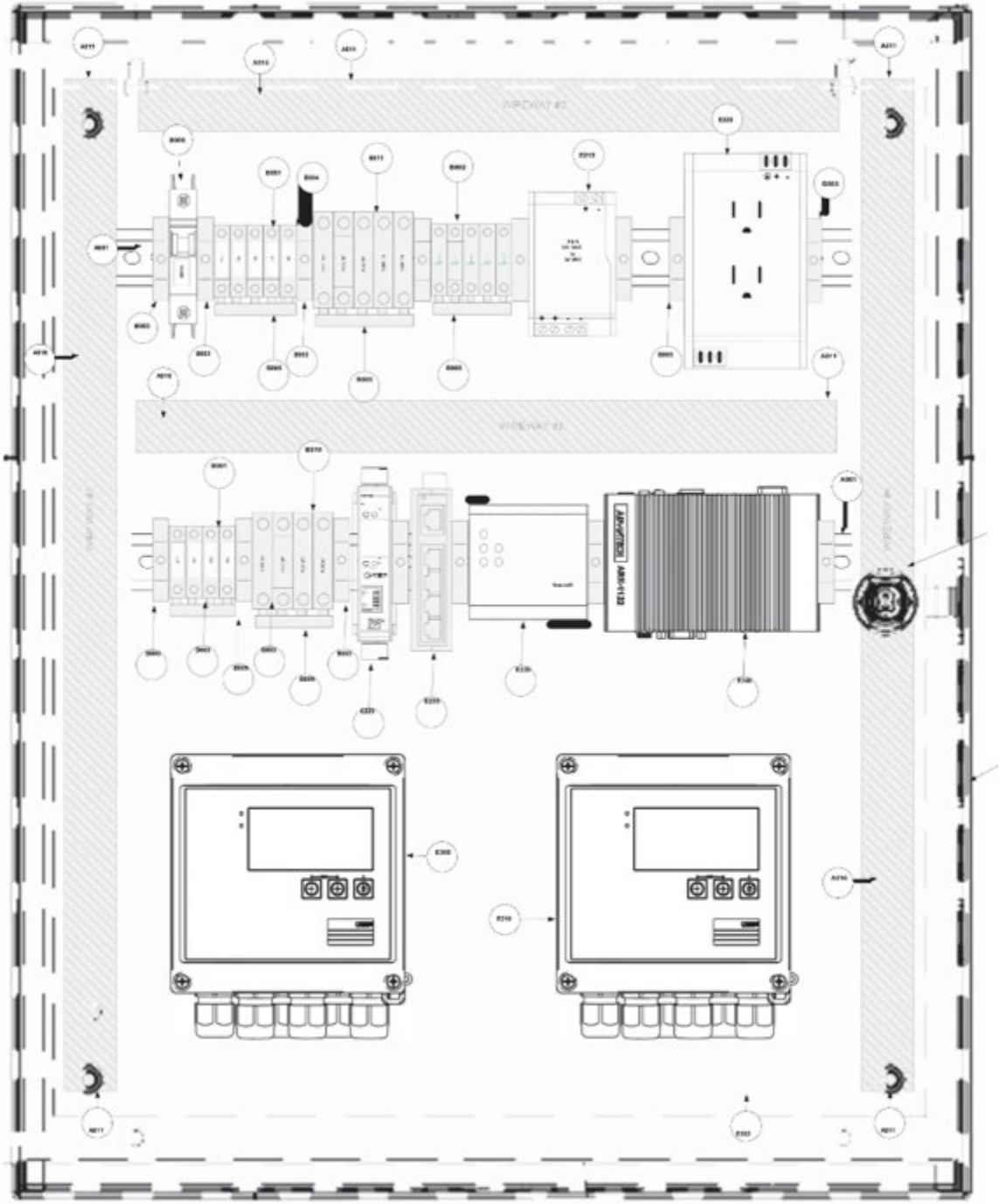
NATURAL GAS METERING

A. Must include a dedicated pressure regulating valve installed upstream of the meter.
B. Remote registers shall be provided when the meter location prevents direct reading of the meter register from a standing position on grade or finished floor. Remote registers shall be installed at 4 feet to 5 feet above grade or finished floor.. Remote registers shall be compatible with the installed meter and shall have an odometer-style display.
C. Design Professional shall design for Modbus TCP or RTU slave communications to give data back to the Utility Metering Panel (UMP). This may require the UMP to be fitted with a DIN rail, frequency to Modbus RTU slave device.
D. Design Professional shall furnish detailed wiring diagrams in the contract drawings for both meter power and communication connections.
E. Easy access shall be provided to meters for maintenance, repairs and meters shall be circular flanged and valved to permit convenient replacement of metering.

CONTRACTOR GUARANTEE

A. Contractor shall guarantee all equipment against defects in material and workmanship for a period of two years from date of project acceptance. During the warranty period, Contractor shall provide all labor and material required to repair or replace defective equipment at no cost to the University.

TYPICAL UTILITY METERING PANEL LAYOUT



ITEM #	DESCRIPTION	VENDOR	VENDOR#	QTY
A001	3.5 cm (1.38 inch) T-type DIN Rail	Altech	2511120/1M	3
A011	PANDUIT Type G Wide Finger Slotted Duct, PVC, 1in X 3in X 6ft, LGRY	Panduit	G1X3LG6	2
A016	Duct Cover, PVC, 1in X 6ft, LGRY	Panduit	C1LG6	2
B001	UK 10 N Gray IEC Screw Clamp Terminal Block - 24-6 AWG	Phoenix Contact	3005073	9
B002	USLKG10 N Ground Terminal Block 20-6 AWG, Green-Yellow	Phoenix Contact	3003923	5
B003	E/UK Terminal Block, Universal End Bracket	Phoenix Contact	1201442	15
B004	D-UK 4/10 Cover; Terminal Block and Strips	Phoenix Contact	3003020	5
B005	EB10-10 Insertion Bridge; 10; Terminal Block and Strips	Phoenix Contact	0203137	5
B008	Circuit Breaker; Supplementary; C Curve; 5A; 1-Pole; Single Pkg; UL 489;	Eaton	FAZ-C5/1-NA-SP	1
B010	UK 6.3 HESILED 24 Fuse disconect with LED (24VDC)	Phoenix Contact	3004265	4
B011	UK 6.3 HESILA 250 Fuse disconect with LED (110VAC)	Phoenix Contact	3004249	5
E200	Enclosure; Box-Lid; Wallmount; Steel; Gray; 30x24x6.62 In; NEMA 1; Hinged;	Hoffman	A30N24ALP	1
E201	CYLINDER LOCK KIT; TYPE 1; STEEL;	Hoffman	AL12AR	1
E202	Panel, N1, Perf., 26.00x22.50 Gray, fits 30x24, Steel	Hoffman	A30N24MPP	1
E215	Power Supply; AC-DC; 24V@0.5A; 85-264V In; Enclosed; DIN Rail Mount; STE	Phoenix Contact	2868648	1
E220	Duplex Outlet; 15A; 120VAC; DIN Mount; Finger-Safe; Black; PVC; 5.32x2.95x	Acme Electric	DRR-15	1
E225	Acromag Ethernet Analog Output Modules	Acromag	972EN-4006	1
E230	Industrial DIN Rail, High Temp, 5 port ethernet switch	Starcom		1
E235	EGX100SD - SyBus ETHERNET GTWY, RS485/RS232, 10/100 BASE TX	Schnieder Elect	EGX100SD	1
E240	Fanless Embedded IOT Gateway	Advantech	ARK-1122F-S8A1E	1
E300	EngyCal RH33 Heat Counter	Endress + Hauser	RH33-CP1A+AAB1D1LUP3	1
E310	EngyCal RS33 Steam- and Saturated-Steam-Calculator	Endress + Hauser	RS33-CP1+AAB1D1LUP3	1

GENERAL INSTRUCTIONS
CAMPUS STANDARDS
JULY 2023

Drawing Format

- The full drawing set with all disciplines will be one Bluebeam file.
- Each sheet regardless of discipline must have matching title blocks & fonts and must include the UCLA project title, UCLA project number and issue date.
- Each sheet must be titled and numbered
- The issue name with dates as the project progresses must be updated on all sheets.
- The set must include a key plan indicating the location of project within the building

Specification Format

SPECS must be included with your review starting at the 100% DD phase of the project. They should always be included with all reviews in the project BB invite in its own SPECS folder.

- **Specs folder** should be labeled as see in this sample: 230131-SPECS- CP1234
- **Approved Specs** should be labeled as seen in the sample below:
  220320 (current date)- CP1234 Specs-Approved on 230210

- **Specs included on Drawings**: Drawings that include specifications (not book format) should be submitted as one file in each BB session or project.

- **Book Format Specs:** Projects with Specifications in book format are to be submitted with the drawings in the same BB session.
  - The date on the Specs and the drawings must be the same.
  - There should be two files, one for the drawings and one for the book specifications at each milestone.
- **UPJO Specs:** UPJO specs should be listed on the front sheet of the permit set.
  - They should be listed with title & date for each spec for which a job will be performed. i.e.: “UPJO Spec-Discipline-Date”.
  - The same listing should appear on the workflow general instructions section.

Bulletins & Addendums

All Bulletins & Addendums that present a change to the original permit set must be submitted for CBO approval.

- Addendums are submitted during bidding or before a contract is awarded

- Bulletins are submitted after the contract is awarded or during construction.

1. They must be submitted via a workflow using the workflow template listed below:
2. Engineering-Approval: Bulletin/Addendum (Requires a Bluebeam Project Invite).
3. They must be numbered in the order they are submitted: #1, #2, #3, etc.
4. The discipline impacted must be listed: Electrical, Plumbing, etc.
5. Bulletins & Addendums will only be reviewed in sequential order. Therefore, all bulletins & addendums need to be approved & submitted accordingly for all projects.

CONTRACTUAL ADDENDUMS AND BULLETINS

Addendums and Bulletins that are Contractual only and do not present any changes to the original permit set do not need the CBO's approval. However, they must be submitted to our E-PlanRoom. They must be submitted in PDF format to Suzy Sullivan and labeled as seen below: "**BULLETIN# CONTRACTUAL ONLY**".