1.1 GOALS

The goal of this section is to provide guidance in the design of Mechanical HVAC systems to LAWA standards. The LAWA Mechanical Design Standards are a compilation of general design and construction practices that are already in place in our facilities, as well as recent discoveries that should be implemented throughout the facilities to maximize the performance of existing systems, minimize maintenance costs and improve the travelling public's experience. These standards are by no means an exhaustive description of all items practiced in our facilities; however, this document does present LAWA's standards for most of the major mechanical systems. If any discrepancy is found between these standards and the LAWA Design & Construction Handbook, the more restrictive standards shall take precedence.

1.2 GENERAL

A. Design Requirements

1. All systems and equipment shall comply with applicable building and mechanical codes, LAWA criteria, and the scope of project work.
2. Provide design, engineering, permits, installation, start-up, testing, adjusting, balancing, and commissioning of complete HVAC, plumbing and fire protection systems. The Contractor shall review all the documents and comply with the requirements.
3. Address the presence of hazardous materials. There is a high probability that portions of the existing HVAC systems, piping, insulation and the like may contain lead based-paint, asbestos containing materials (ACM's) and/or other materials classified as toxic or hazardous by LAWA or Federal regulations. The Contractor, and the Contractor's designer, must consider the impact of hazardous materials on this project.
4. Designs shall utilize systems and products that are/have:
   a. Long-life, industrial quality.
   b. Readily-available products and components with service support available.
   c. Maintainable arrangements with multiple units.
   d. Readily available spare parts and materials that incorporate multiple equipment elements in key systems that can be provided for reduced capacity operation when portions are down for maintenance or failure.
5. The Design Consultant/Contractor shall perform a quality control review of all documents for completeness, constructability and coordination with all building trades.
6. Large Equipment Installation Sequencing: In conjunction with other design disciplines, provide the necessary scheduling, sequencing, movement and positioning of large equipment into the building during construction, including provisions for temporary removal/replacement of existing building components.
7. Special and LAWA-Furnished Equipment: Special types of equipment, including LAWA-furnished and contractor-installed materials, shall be coordinated for correct rough-in and attachment requirements.
8. Interferences: AC units, valves, fans, piping, ducts, pumps and other equipment shall be reviewed for interferences that would prevent proper installation. Coordinate with Capital Programming, Planning & Engineering (CPPE) and Facilities & Technical Services Division (FTSD).
9. Clearances: AC units, valves, fans, piping, ducts, pumps and other equipment shall have a minimum of 30" clearance on all sides, including above, unless mutually agreed upon between the GC and CPPE/FTSD.
10. Accessibility: AC units, valves, fans, piping, ducts, valves, pumps and other equipment shall be coordinated with building construction to provide a minimum 30"x30" access for maintenance, unless mutually agreed upon between the GC and CPPE/FTSD. Piping and ducts shall be coordinated with other engineering disciplines. Clearances and locations shall be demonstrated graphically**.**

11. Penetrations: Piping/utility and duct penetrations through floors, walls and roofs shall be coordinated and identified on the architectural and structural construction drawings. Proper cross-referencing between drawings shall be done. Details for protection of all penetrations of fire resistive construction are required on plans submitted for construction approval permit.
12. Construction of New Buildings over Existing Utilities: Buildings or other structures shall not be constructed over existing or new utility lines except where such utility lines serve the buildings or structures. Utilities interfering with new construction shall be relocated as required. Where relocation is impractical, obtain written permission from CPPE and FTSD.
13. Equipment Protection and System Protection: Project specifications shall clearly indicate that all equipment and systems intended for a project shall be properly protected from damage, corrosion and weather during shipment, in-transit storage, job-site storage, field/shop prep, installation and checkout until the work is accepted by LAWA. Ends of piping, valves and fittings shall be protected from abuse and the entry of moisture. Electrical equipment controls and insulation shall be protected against moisture and water damage. LAWA may, at Contractor's risk and expense, disallow or reject the installation of previously approved equipment, if it is later determined to have deteriorated considerably during the Contractor's custody, such as during shipment, storage and/or installation.
14. Special Support and Anchors: All equipment including piping supports, anchors, supports-guides, and pre-insulated versions thereof, which exerts force on the structure other than those forces produced by gravity, shall be designed to meet Code and detailed on the drawings and coordinated with structural engineer and appropriate fire protection drawings.
15. Where feasible, all equipment shall be arranged for maximum service access, while reserving space for future equipment and future uses. Ensure that all components and equipment are easily accessible for maintenance and replacement. Coordinate with CPPE and FTSD.
16. Install valves to isolate each piece of equipment for maintenance and replacement requirements.
17. All piping, conduits and ductwork shall be concealed from public view and protected from the weather, unless approved in writing by LAWA CPPE.
18. All known and unknown utilities identified during construction shall be shown on the final record drawings, including the record digital data files. See the "LAWA Standards for the Construction Contract" section in the DCH for additional information.
19. All utility lines and equipment proposed to be abandoned shall be demolished and removed. The Engineer/Contractor shall submit demolition drawings identifying the piping and equipment to be demolished and removed.

B. Drawings Requirements

1. Plan Coordination: Work shall be coordinated with all disciplines to ensure that size and location of all required chases, soffits, access panel requirements, etc., are indicated on the plans. All pipes larger than 6" shall be drawn as double lines. Duct layout larger than 6" diameter shall be drawn as double lines.
2. Sectional Views and Elevations: Sectional views and elevations that clearly define the details and space constraints shall be developed from floor plans included within the construction drawings. All equipment rooms shall have a minimum of two composite floor to ceiling sections with the cutting plane through the major axis that defines equipment sizes, and piping, and their relationship to architectural, structural and electrical installations. Identify the clearances necessary to perform preventive maintenance and space requirements for equipment servicing/disassembly by dimensioning, noting and/or cross-hatching.
3. Pump & Fan Rooms: All equipment in Pump, Fan and miscellaneous mechanical rooms shall be designed and located to facilitate the removal, transport and

replacement of the largest equipment component housed within the room. Room locations shall be depicted in plan view with expanded details shown by part plan at a scale no less than 1/4" = 1' – 0". All rooms shall be adequately ventilated and provided with hose bibbs and floor drains. Electrical rooms shall not have hose bibbs.

4. Access to new and existing equipment, valves and other appurtenances: Drawings to include the following note: "Contractor shall coordinate with CPPE and FTSD to determine the location and clearance requirements of existing equipment, valves and other appurtenances in the vicinity of Work that require access or maintenance. Unless otherwise agreed upon, provide minimum 30"x30" access and a minimum of 30" clearance on all sides, including above. The Work shall not restrict the access or maintainability of existing or new equipment, valves and other appurtenances. Shop drawing shall accurately reflect access information."
5. Temporary Isolation Valves – The Contractor shall remove all isolation valves installed for ease of construction upon project completion.
6. Existing abandoned utility lines and equipment found during construction shall be demolished and removed to the limits of the area of work. Coordinate with LAWA CPPE and FTSD.

1.3 HEATING, VENTILATION & AIR CONDITIONING SYSTEMS

A. Submittals

1. Design Phase: A complete package of design calculations and information on the plans shall be provided for review by LAWA. The calculations packages shall be completed in a bound and indexed format and shall be distributed with the final plans and specifications. Calculations shall be provided with whatever markings or notations that are needed to make them clearly understandable.
   a. The following data and calculations are the minimum requirements for submission:
      1) All calculations and designs.
      2) Catalog cuts showing capacities and selection points for all equipment.
      3) Heat and mass balances for all systems.
      4) Pressure drop calculations.
2. Instrumentation design: Include process diagrams, P&I diagrams, wiring diagrams, and catalog information on all equipment. Coordinate design with all vendor control packages to achieve sequences of operation.
3. Provide system schematics for chilled water, heating hot water, water treatment and associated plumbing systems.
4. Submit type of chemical water treatment system and approach proposed for chilled water and heating hot water systems, with sufficient literature to validate approach and technology, along with references from projects and users where system has been employed for at least one year. Specific emphasis should be given to successful treatment programs in connecting new hydronic systems to existing buildings.
5. Project specifications shall clearly indicate that the Contractor shall submit, as a minimum, the following to demonstrate compliance with these requirements.
   a. Shop drawings showing all the duct layout, piping, AC equipment, pumps, valves, and other equipment including piping accessories to complete the work.
   b. Describe phasing of project implementation and strategy.
   c. Manufacturer's product catalog.
   d. HVAC system air balance report.
   e. Copy of manufacturer equipment warranty documents shall be submitted during project closeout.
   f. Supplement, as appropriate, with graphic material to convey the design intent.
   g. Describe approach to commissioning of systems. Identify roles and responsibilities of key players.
   h. Training Schedule. LAWA to attend the equipment operations training. LAWA maintenance personnel shall be properly trained in the operation and

maintenance of all installed HVAC system for minimum of 8 hours (4 hours classroom training and 4 hours hands-on) prior to final acceptance by LAWA.

B. Design

1. All HVAC packaged rooftop units larger than 5 tons shall have motors with Variable Frequency Drives (VFD), Maximum distance allowed between VFDs and motors served shall be in accordance with CEC and manufacturers application guidelines.
2. Provide manufacturer's recommended space for a service access envelope around each AC unit, Air Handling Unit (AHU), Pump, Boiler, Fan, Cooling Tower, Heat Exchanger, VAV box, Fan coil, Fans and accessories for service in all dimensions.
3. Provide note on the plan that the bottom of the VAV box shall be located a maximum of 12 inches above ceiling for inspection and maintenance access to damper, coils, control panel, valves and other accessories.
4. Provide minimum of 30 inches clear space in front of VAV box and fan coil unit instrument and control panels for inspection and maintenance access.
5. All HVAC equipment hung or mounted shall be provided with vibration isolators and seismic restraints unless otherwise noted per manufacturer recommendation.
6. No AHU shall be located outside of the designated Mechanical Room.
7. No AHU shall be located on the roof, unless approved by LAWA CPPE.
8. Mechanical equipment (VAV boxes, FCU's, controls, etc.) requiring maintenance serving the men's and women's public restrooms shall be located outside of the footprint of the restrooms.

C. Calculations

1. Calculations and compliance documentation shall comply with California Title 24, Part 6 Energy Code. Provide detailed engineering calculations for all systems to confirm final sizes and equipment and system efficiencies and submit for approval by LAWA. Include the performance criteria, identifying minimum levels of the materials and workmanship quality.
2. Cooling and heating load calculations shall be per the ASHRAE method. Load calculations will also conform to the California Energy Commission T-24 calculations, including safety factors. Cooling and heating load calculations shall be provided in formal submittal format for review at the completion of the Design Development (DD).
3. Define occupant density per ASHRAE Standard 62.

D. Testing, Adjusting, and Balancing

1. Project specifications shall clearly indicate the following:
    a. All installed HVAC system shall be air and water balanced by a certified third party balancing company approved by LAWA.
    b. Testing Agency:
        1) Total System Balance shall be performed by the independent, non-affiliated Contractor, certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB). Contractor shall specialize in the balancing and testing of the ventilating and air conditioning systems. Contractor shall be capable of balancing, adjustment, and testing of the air moving distribution systems, water and steam systems.
        2) Minimum of 5 years of Air Balancing and testing experience and proof of having successfully completed at least 5 projects of similar size and scope is required.
        3) All work shall comply with applicable procedures and standards published by the AABC or NEBB.
    c. Test and Balance Reports

1) The Test and Balance agency shall prepare and submit minimum of three (3) copies of the Test and Balance Analysis to LAWA within five (5) working days of completion. This report shall contain, at a minimum:
   i. AABC or NEBB Certification credentials for the responsible Air Balance Company and all certified technicians, involved in the project.
   ii. Project Summary and comments.
   iii. Table of contents and test forms for all systems.
   iv. Calibration certificates for all test equipment.
   v. Drawings:
      (a) Full scale single line schematic drawings showing the actual duct runs and outlet/inlet locations.
      (b) Drawings shall be in the latest AutoCAD format.
   vi. Copy of AABC or NEBB performance guaranty.
   vii. Copy of data for all supply fans.
   viii. Copy of data for the coils.
   ix. Copy of data for the pumps.
   x. Chilled Water Piping Balance Report
   xi. Heating Water Piping Balance Report.
   xii. Steam Piping Balance Report.
   xiii. Condensate Piping Balance Report.

d. Guarantee
   1) Air Balance Testing agency shall provide an extended 1 Year warranty after completion of test and balance work for recheck or resetting of any outlet, supply air fan, VAV box, return/exhaust fan or pump as listed in test report.

E. Building Commissioning

1. Project Specifications shall clearly indicate the following:
   a. That an independent certified Building Commissioning agent shall provide commissioning services.
   b. Minimum guidelines of commissioning shall be per the latest ASHRAE “Guideline 0 The Commissioning Process” and ASHRAE “Guideline 1.1: HVAC&R Technical Requirements for The Commissioning Process”.
   c. All installed HVAC systems shall be commissioned prior to final acceptance by LAWA.

F. HVAC Piping

1. Equipment air vents: Schedule 40 black steel or Type L hard drawn copper pipe.
2. Piping Identification Markings and Color Codes: Piping and Duct Identification Markings and Color Codes shall be in accordance with ANSI A13.1 standards. Markings shall include arrows indicating direction of flow. Markings shall be installed at a minimum of every 20' on straight runs where there are no visibility obstructions. In areas where visibility of pipe or duct is obstructed or numerous other pipes and ducts exist, markings shall be installed as approved to enable pipes and ducts to be easily traced along its entire path. Pipes shall be marked and color-coded.
3. Installation methods shall be in accordance to the latest edition of the Los Angeles Plumbing Code.
   a. No piping connections shall be made through hot tapping method unless approved by LADBS and LAWA. Provide connections with standard tee fittings and reducers where hot tapping method is not used.
      1) Prior to performing the work, piping connections made through hot tapping method or pipe freezing process to chilled water and heating hot water lines connected to the CUP shall be approved by the LAWA CUP Chief Building Operating Engineer.

b. Victaulic fittings shall not be used in the heating hot water systems.
c. Provide a brass ball valve and a 6" brass nipple at each location where the piping transitions from copper to steel. Dielectric fittings, flanges and unions shall NOT be used on any piping, except dielectric flanges may be used inside the mechanical and pump rooms. Additionally, dielectric unions MAY be used in natural gas piping at the meter and at the equipment connections.

4. Thermometers and pressure gages shall be provided on chilled and hot water supply and return lines at every Air Handling Unit.
5. Isolation valves shall be provided at the equipment's connection to the chilled water and heating hot water piping.
6. Drain valves shall be provided at the low point of the chilled water and heating hot water systems. Drain piping shall be terminated at Code approved receptacle.
7. Air vents shall be provided at the high points of the chilled and heating hot water systems.
8. Pressure independent flow balancing valves shall be provided on the chilled and heating hot water main lines.
9. Condensate from HVAC equipment shall be gravity drained and discharged to a code approved receptacle. The Contractor shall obtain permission from LAWA CPPE and FTSD for installation of a condensate pump in the event that a gravity drain is either impractical or impossible.

G. Mechanical/ Mechanical Storage/ Pump Room

1. Only mechanical equipment shall be allowed in the Mechanical room, mechanical storage room and pump room.
2. Mechanical rooms, mechanical storage rooms and pump rooms shall not be converted for lease space or similar without approval from the LAWA CPPE.

H. Computer Room (Small Room)

See "Information Management and Technology Group (IMTG) IT Design Guidelines Summary Document" for the MPOE and Computer Rooms Cooling and Fire Protection Requirements.

I. UPS/Battery Room

See "Information Management and Technology Group (IMTG) IT Design Guidelines Summary Document" for the UPS/Battery Room Cooling and Fire Protection Requirements.

J. Electrical Room

1. Provide split system AC unit manufactured by Carrier, Data-Aire or Compu-Aire. It includes a wall mounted microprocessor, dirty filter alarm, humidifier, electric reheat, disconnect switch, oversized evaporator fan motor, condensate pump and tank, as well as phenolic coating on the condenser coil.
2. Condenser unit shall be installed outdoors on minimum 4" high mounting pad, vibration isolator, and 10 mils phenolic baked exterior coating corrosion protection.
3. Interface the UPS/Battery Room exhaust air and make-up air equipment with the BAS for the remote status and alarm monitoring.

K. Elevator Machine Room

1. Provide split system AC unit manufactured by Carrier, Data-Aire or Compu-Aire. It includes a wall mounted microprocessor, dirty filter alarm, humidifier, electric reheat, disconnect switch, oversized evaporator fan motor, condensate pump and tank, as well as phenolic coating on the condenser coil.
2. Condenser unit shall be on the roof, with minimum 4" mounting pad, vibration isolator, and 10 mils phenolic baked exterior coating corrosion protection.
3. Interface Elevator Machine Room Air Conditioning Equipment with the BAS for the remote status and alarms monitoring.

L. General Exhaust

1. The toilet rooms and janitor closets shall be under negative pressure and interconnected where possible to common exhaust fans.
2. Each restroom and janitor room shall be provided with adequate exhaust ventilation at minimum of 15 air changes per hour. Make up air shall be provided by the HVAC system. Transfer air from above ceiling space or adjacent room not acceptable.
3. For all locations, other than restrooms, provide with a minimum six air changes per hour ventilation rate.
4. Interface Exhaust Fans with the BAS for remote status and alarm monitoring.

M. Boilers

1. Interface heating boilers with the BAS for remote status and alarm monitoring.

N. Air Side Design

1. Duct systems shall be designed with maximum velocities as follows:
   a. Supply Ductwork: 1900 feet per minute for main ductwork. Pressure drop of 0.10 inch water gage per hundred feet for main ducts and 0.05 inch water gage per hundred feet for ducts downstream of VAV boxes.
   b. Exhaust/Return Ductwork: 1800 feet per minute for main ductwork. Pressure drop of 0.10 inch water gage per hundred feet.
   c. Ductwork shall be fabricated for appropriate pressure class.
2. All occupied spaces shall meet room noise criteria (NC) of NC-35, except for conference and meeting rooms that shall be less than NC-30.
3. Within ceiling spaces, flexible duct shall be used to connect the supply air diffuser/ register to the rigid duct. Flexible duct shall not exceed seven (7) feet in length.
4. Manual volume dampers shall be provided for every supply air outlet. The damper shall be located on the branch line serving the supply air outlet at the take-off from the main duct. Manual volume dampers shall be accessible. Provide access opening to manual volume dampers located in areas with gypsum board ceiling with the identification streamer/tag in addition to Young regulator for remote operated manual volume dampers.
5. Select and schedule new VAV terminal units per LAWA's approval.
   a. All VAV terminal units shall be seismically braced without regard to the weight limit in the Code. VAV boxes shall be supported without regard to adjacent ductwork and must be self-supporting. VAV terminal units shall be designed to resist seismic forces in all directions. Tension-only bracing is not allowed; Compression struts are required. See Airport Structural Design Standards for additional information.
   b. Unit support for VAV terminal units shall be designed by a California licensed Civil or Structural Engineer.
   c. Unit support for VAV terminal units shall be submitted to LAWA CPPE for approval.
6. When the lease space is renovated or remodeled, entire air distribution system shall be replaced, including the VAV boxes, ductwork, registers, grilles and diffusers.
7. When the lease space is renovated, new VAV boxes shall be provided with the new DDC controllers capable of being integrated into the BAS.
8. Existing ductwork
   a. In the event that the existing air distribution system within the renovated space is deemed to be in working condition, it needs to be cleaned by the third party certified duct cleaner.
   b. Existing air distribution system shall be balanced according to the new air flow requirements.

O. Air Handling Units

1. Select and schedule proper equipment customized for the project requirements.
2. Coordinate design and placement of new equipment with architect and structural engineer.
3. Unit shall be mounted on minimum 4" high concrete platform or equipment roof curb with 2" deflection spring vibration isolators and seismic restraints.
4. Exterior panels shall be minimum 20 gauge steel, pre-coated with minimum 6 mils topcoat phenolic baked coating over 4 mils epoxy primer for a total of 10 mils. Coating shall withstand 5,000 hours of salt spray per ASTM B-117. Coating shall be applied at the factory.
5. Refrigerant shall be R410a.
6. Design Conditions
   a. Outdoor Design:
      1) Summer dry bulb design temperature (Fahrenheit): 91° F @ 0.1%.
      2) Summer wet bulb design temperature (Fahrenheit): 71° F@ 0.1%.
      3) Summer design temperature: 101°F.
      4) Winter design temperature (Fahrenheit): 40° F @ 0.2%.
   b. Indoor Design:
      1) Indoor conditions for all spaces in the building shall be defined at 72 degree F for cooling and 70 degree F for heating. UPS, IT MPOE and telecommunication rooms shall be designed for 68 degree F.
7. Interface the AHU controls with the BAS for remote monitoring and control.
8. Units shall be listed by the California Energy Commission and comply with T-24 requirements.
9. <u>HVAC Packaged Rooftop Units (RTU)</u>
   a. Custom units larger than 5 tons.
      (1) Provide one of the following two air cleaning options.
         (a) MERV 8 pre-filter, carbon filter, bipolar ionization unit and MERV 13 final filter as well as ultraviolet light for the coil section.
         (b) MERV 8 pre-filter, PCO and MERV 13 final filter as well as ultraviolet light for the coil section, with written approval from CPPE and FTSD.
      (2) Provide with economizer controls, variable frequency drive for the fan(s).
      (3) Units larger than 15 tons shall be factory tested, witnessed and certified by LAWA CPPE and LAWA Inspector prior to shipping to the job site.
   b. Non-custom units of 5 tons or less.
      (1) MERV 8 pre-filter and MERV 13 final filter.
   c. Thermostat shall be electric 365 days programmable type
10. <u>Central Station Air Handling Units (AHU)</u>
   a) Provide one of the following two air cleaning options.
      (1) MERV 8 pre-filter, carbon filter, bipolar ionization unit and MERV 13 final filter as well as ultraviolet light for the coil section.
      (2) MERV 8 pre-filter, PCO and MERV 13 final filter as well as ultraviolet light for the coil section, with written approval from CPPE and FTSD.
   b) All custom AHUs larger than 15 tons shall be factory tested, witnessed and certified by LAWA CPPE and LAWA Inspector prior to shipping to the job site.
   c) For existing Central Station AHUs that are to be refurbished, make revisions to the existing equipment to add these air cleaning options where possible. If not, advise LAWA.

P. Building Automation System (BAS)

1. The BAS shall monitor and control all building mechanical systems and equipment. Each mechanical system shall be complete with factory controls, and shall be specified with accessory integration modules, hardware, computer cards, and software required for full and complete integration to the BAS. The BAS shall monitor mechanical equipment for failure alarms, and all operating set point variables shall be capable of being reset.

2. BAS shall include equipment graphical representation and floor plans showing layout of equipment and control points.
3. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BAS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like. BAS shall have web based monitoring and control capabilities.
4. The BAS shall consist of networked controllers capable of stand alone control and integrations with the existing building BAS.

Q. Terminal/Building HVAC System

1. Submit schematic piping flow diagrams and control valves for the Terminal pump rooms and HVAC systems. Schedule all coil and pump sizes and estimated capacities. Include all control valves in piping diagram. Provide test and balance data indicating the existing flow distribution in the Central Terminal Area (CTA). List all control valves. Identify all chilled water pumps, including branch pumps at ends of existing loop to any coils or systems. Verify if there are any existing 3-way valves or other valve-bypasses, which are diverting flow to the return system.
2. Prepare a load calculation to determine design criteria and recommended capacities.
3. Submit summary report to LAWA as part of Basis of Design Submittal to whether the pump can be simply adjusted for flow, left alone, impeller or motor changed or whether a complete pump change-out is required.
4. Work shall be phased to keep building operations uninterrupted.
5. The system design shall provide flexibility in terms of operation and renovation.
6. The operation, reliability and redundancy of the existing CUP systems shall be maintained throughout the construction. All work requiring a temporary shutdown of services shall be coordinated with LAWA to minimize disruptions.
7. Site investigation: The Contractor shall conduct a site investigation and thorough survey and prepare drawings as necessary to complete construction documents and phasing plans.
8. Field Painting: Provide field painting of all piping, and miscellaneous appurtenances. Provide labeling and identification of all equipment and piping. LAWA to select colors.
   a. Piping labeling shall include color coded arrows, with the line number, commodity inside and direction at regular intervals over the pipe jacketing.
9. All systems shall be properly cleaned and flushed and tested prior to energizing.
10. Accessibility: Install all components, valves, control devices, etc. where they are accessible for operation and maintenance without use of portable ladders. Provide platforms, stairways, fixed ladders, etc. as required.
11. Pipe Sizing: Piping shall be sized for maximum flows in the chilled water pipe not to exceed 12 feet per second (fps) in mains and 10 fps in branches to coils and pumps. Maximum pipe velocity of 12 fps for piping 8" and larger. All piping shall be sized to not exceed a pressure drop of 4-ft head per 100 feet of piping. The dedicated branch coil piping runs out to each coil shall be sized for the individual coil size and chiller flow capacity calculated at new design conditions.
12. Provide individual sub-meter for the chilled water and heating hot water lines from the CUP to each tenant area with option for future remote data gathering connection.
13. CUP Heating Hot Water Design Supply/Return Temperatures:
    a. Primary Loop – 220/170 degrees F.
    b. Secondary Loop – 180/140 degrees F.
14. CUP Chilled Water Design Supply/Return Temperatures:
    a. 40/56 degrees F. The CUP operates most efficiently with a 16 degree F delta T.
15. Provide isolation valves on the supply and return lines at the point of entry to all buildings for all Heating Hot Water and Chilled Water distribution systems.