Division 230500
Common Work Results for HVAC
DESIGN GUIDE

1 General

1.1 General

A. All mechanical systems chosen for use on the University campus shall consider long-term ownership, and their operation and maintenance needs.

B. Provide facility piping diagrams for all hydronic systems utility service, major equipment and overall distribution or mains by floor.

C. Systems and construction methods shall be chosen based on a useful life of 25 to 30 years.

D. Engineers shall visit the campus at the end of each major design phase unless previously arranged to have a virtual meeting to present the design and system approach and review documents with the MHM and MPM. This includes but is not limited to controls discussion when control diagrams are completed and serviceability as discussed elsewhere in this document.

E. Occupied spaces shall be designed for the maximum number of space occupants: the larger of the furniture plans or the maximum allowed by building code occupancy for the associated space type.

1.2 Permitting

A. In addition to submission of normal permitting to the AHJ for mechanical/plumbing and fire protection review, the design engineer is advised that all regulated emission sources are required to be

permitted by the Department of Ecology. The design engineer is responsible for permitting of air emissions with the Department of Ecology. This includes new fuel fired equipment, spray paint booths and other emission sources. This includes even small loads such as small gas fired water heaters.

B. The campus operates under a single permit and each project with emissions, requires a notice of construction that is filed with the Department of Ecology complete with emissions calculations and a best available control technology analysis. The consultant fees shall include the permitting costs associated with Department of Ecology.

C. The Department of Ecology requires that in addition to the project being permitted that the application include all source emissions permitted by CWU in the three year period leading up to the required permit. Landau and Associates has assisted with many of the campus emission permits.

D. CWU contact for the campus Department of Ecology permit is the Campus Building Energy Engineer.

1.3 Life Cycle Cost Analysis

A. In accordance with RCW 39.35, for facilities greater than 20,000 square feet, perform a Life Cycle Cost Analysis (LCCA) in conjunction with the Architect, Mechanical Engineer, and Electrical Engineer.

B. Prior to commencement of the LCCA, the work plan identifying options for study for the LCCA shall be reviewed and approved by the Capital Planning Project Manager (CPPM) and the Mechanical HVAC Manager (MHM).

C. Utilize the Life Cycle Cost Model (LCCM) developed by the Washington Office of Fiscal Management (OFM) and prepare model in accordance with https://ofm.wa.gov/facilities/facility-life-cycle-cost-model .

D. This comprehensive analysis encompasses the total building construction and operating costs and is performed in the pre-design and the design phase.

1.4 Codes and Standards

A. Codes shall be most recent addition, adopted by the State of Washington or these adopted by the LEED version being pursued for certification.

B. Facility design and installation shall conform to the following codes and standards.

1. American Disabilities Act
2. American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures ASCE 7 (seismic)
3. ASHRAE Standard 55-Thermal Environmental Conditions for Human Occupancy
4. ASHRAE Standard 62-Ventilation for Acceptable Indoor Air Quality
5. International Mechanical Code
6. National Electrical Code
7. Washington State Energy Code
8. Washington State Boiler and Unfired Pressure Vessel Code
9. Applicable state and local ordinances and regulatory agencies

C. All mechanical equipment with electrical connections shall be listed by UL or other nationally recognized testing laboratory (NRTL). Where required by Division 26, indicate the required short-circuit current rating (SCCR) for the equipment on the equipment schedules.

1.5 LEED

A. Major facility projects receiving funding from the state capital budget or through a financing contract as defined in RCW 39.94.020 shall be certified at the level of Silver or higher. CWU has goals of reaching certification levels of Gold or higher when practical.

B. Major facilities includes major new construction and renovation projects over 5,000 GSF where the renovation costs exceed 50% of the building assessed value.

1.6 Efficiency

A. All selected HVAC units shall be of the highest energy efficiency possible.

1.7 Mechanical Rooms

A. The campus has very high seasonal groundwater due to irrigation water in the canal that passes through campus.

B. Basement mechanical spaces shall be avoided unless specific permission is granted by the CPPM. The design team shall demonstrate precautions to prevent ground water intrusion into the mechanical room.

C. Access panels or doors must be large enough to allow the removal of any and all mechanical system components located within. This will frequently require double doors for removal of larger pieces of equipment.

D. It is preferred that mechanical equipment rooms be fully enclosed and roofed. Exception: heat recovery air handling units on flat roofs are acceptable. Walking pads shall be provided on membrane roofs between the roof access and the equipment.

E. Where major equipment is in a penthouse or on the roof, service access shall be provided by:

1. Elevators are preferred.

2. Regular stair-not preferred. Review equipment service and replacement with the mechanical plumbing manger and mechanical HVAC manager.

3. Ships ladder or alternating tread stair are permitted only when approved by the Capital Planning Project Manager.

4. If/when ladders/stairs are provided, provide hoist and beam or lifting crane at top of stair to allowing removal and reinstallation of major equipment.

F. Rooms located above grade:

1. Coordinate construction with the project architect as it relates to water proofing of elevated equipment rooms (excluding slab on grade areas).
2. Best practices include:
    a. Area floor drains with sloping of floor to area drains
    b. Epoxy coating on floor
    c. Concrete 6” curbs around perimeter of room, around pipe shafts and duct shafts.
    d. Isolated pipe and conduit penetrations may utilize an oversized sleeve with a 2” water stop poured in place in the slab that terminates a minimum of 4" above the floor or a mechanical rubber pipe seal such as “Link-Seal”. When floor is part of a fire rated assembly, the penetrations shall be approved with UL as part of the fire rating.

1.8 Roof Mounted Equipment

A. All roof-mounted equipment must consider re-roofing and roofing maintenance and/or repair operations.

1.9 Backup Power

A. Coordinate with division 26 to have back-up power provided to the following systems
    1. Life Safety Systems
    2. Code required elements
    3. Steam Condensate Pumps
    4. Temperature Controls
    5. Cooling associated with telecom IDF/MDF rooms
    6. Heat trace for pipe subject to freezing
    7. Global controllers as provided with the Building Automation System (refer to 230900).

8. As required for facility program

1.10 BIM modeling

A. Contractors shall participate with the BIM modeling if required in Division 1.

1.11 Serviceability

A. Install systems (piping, ductwork, equipment, accessories) to facilitate maintenance and repair or replacement.

B. Design and construction shall provide easy access to serviceable components in the mechanical systems.

1. Engineer shall demonstrate access in building BIM model to the Mechanical Plumbing and HVAC Manager during the design phase.

2. Serviceability shall consider height above ceiling. Valves and equipment to be installed to allow reasonable access from ladder with a normal reach.

3. Contractor shall demonstrate service prior to project substantial completion after ceilings are installed. A preliminary walkthrough prior to the ceiling tiles being installed is highly recommended.

C. For equipment located above ceilings, access shall consider other systems above the ceiling as well as devices in the ceiling system that may impede access such as sprinkler heads, occupancy sensors, lights, smoke detectors, etc.

D. Allow for coil removal and replacement in mechanical rooms. Provide access to all DDC system controllers, fans, filters, balancing dampers and other equipment requiring service.

E. Access panels need to be a minimum of 18x18 for hand reach, 24 x 24 for person access (shoulders through). Access panels-location and size shall be coordinated with Division 8. Excessively heavy panels or unusually large ceiling panels shall be hinged.

F. Allow a minimum of 24-36" clearance for operator's access to all equipment, including (specifically) coils and the controls side of volume regulating air terminal units. This clearance may need to be increased to allow for the removal and/or replacement of any and all items within

the units which may need to be removed for servicing and/or repair operations. There must also be adequate clearance for the replacement of filters and valves access for air terminal units and other terminal heat transfer units.

G. Clearances around base mounted pump motors. For large motors: maintain 30” minimum on one side for motor removal and minimum 18” between back-to-back pumps.

1.12 Telecom Rooms (MDF/IDF)

A. No piping may be run over telecom rooms except for the branch piping servicing the cooling units. Main piping shall be routed around telecom rooms.

B. Most applications will require mechanical cooling. The university has attempted cooling through simple air exchange with plenum air (without mechanical cooling) and generally they have regretted this. When practical, cooling shall be refrigerant based due to campus chilled water system not being operational in the winter. High priority shall be given to economizer cooling due to campus’s requirements for high performing buildings,

C. Cooling shall be provided from standalone systems so that central air systems are not required to operate at times when they would otherwise be turned off during the unoccupied hours and is rooms/cooling are operational in the event of a power outage.

1. Exception: Buildings operating 24 hours a day, 7 days a week (such as lab buildings) may have cooling provided from the main air systems provided the system has year round cooling.

D. Coordinate indoor unit cooling location or diffuser location with the Telecom Engineer and IS manager. Generally split system units are located above the service door entering the room but location, at times, may need to be adjusted to direct cold air so that it enters the front end of the IT equipment where air is drawn through the IT equipment.

E. Space temperatures shall be maintained at conditions described later in this section.

F. Provide a minimum amount of ventilation air into each telecom room to maintain the space at slightly positive pressure when the building is normally occupied.

G. Minimize ductwork over IT rooms. Where ducts are unavoidable, arrange ductwork to not interfere with location where cable tray enters the room, where pathways for vertical risers have been established, the room or interferes with access to equipment. Generally, bottom of ductwork should be held at least 9’6” above finished floor and preferably much higher.

1.13 Custodial Rooms

A. Do not locate utility panels, pipe chases, mechanical equipment or roof hatches within the closet.

1.14 Drawings

A. As part of the construction documents, the engineer shall prepare one-line diagrams of the following systems. One-line diagrams are intended to be high level schematic plans that quickly indicate major equipment and arrangement as well as areas of building serviced.

1. Heating Water.
2. Chilled Water.
3. Supply Air Systems.
4. Centralized Exhaust systems
5. Smoke Evacuation System.

1.15 Training

A. Provide training on all systems and equipment prior to project completion. Training shall be recorded by video and shall be a combination of classroom training and site walk-through.

B. Provide a second training session and facility walkthrough one month before expiration of the one-year warranty.

C. When equipment is indicated to have start-up by factory trained technicians, training shall be performed at the time of start up by the factory trained technicians.

1.16 Factory Start-Up

A. Provide as indicated throughout specifications.

1.17 Project Closeout

A. Refer to Division 1 for supplemental requirements

B. Project Record Drawings

1. Contractor shall maintain a single set of neatly annotated mark ups (digital or hard copy) in the field that include as installed deviations from the contract engineered drawings.

2. The Owner's representative and the contractor shall review these monthly at the time of pay application.

3. The contractor's fabrication drawings or BIM coordination documents, while helpful, are not acceptable as record drawings as they do not typically include the same content (annotation, sizing etc.) as the contract engineered drawings and they do not typically clearly indicate where deviations are made to the contract engineered drawings.

4. At project closeout, submit annotated record drawings to the Owner's representative as part of the closeout materials.

5. The Architect/Engineer will be responsible for drafting the contractor's record drawings into electronic record files. Deliverables to the Owner include:

    a. Original BIM Model (if utilized)

    b. Exports of each plan into Auto-CAD DWG files with each piping or duct type on a separate layer.

    c. Fire dampers and smoke dampers shall additionally be separated on a separate layer for the owner's preventative maintenance program to facilitate annual inspections.

1.18 Acoustics

A. Systems shall be designed and installed to meet the maximum noise criteria (NC) established for each space.

1.19 Vibration and Seismic Controls

A. Provide in accordance with 230548

1.20 Utilities

A. Low Temperature Heating Water: See 232100

B. Campus Chilled Water: See 232100.

C. Campus Steam and Condensate: See 232200.

D. Natural Gas: See 231000.

1.21 Utility Costs

A. When utilities for a building are generated from heat sources at the central plant or from electric sources connected to the campus owned medium voltage power loop, these utilities have negotiated agreements with the Utility Company.

B. Energy modeling for campus steam projects shall model plant efficiency and include transmissions losses.

C. Rates effective in 2021 are:

	Natural Gas			Electricity		
	Total Consumption (therms)	Total charges	$/therm	Total consumption (kWh)	Total Charges ($)	Cost ($/kWH)
2021	2,087,071	$1,256,798	$0.6022	38,145,600	$1,810,854	$0.0475
1. Electric charges are for medium voltage campus owned loop connected to Wildcat Way and Chestnut Street meters (E600) and are inclusive of demand and consumptive charges. City of Ellensburg Tariff E600.						
2. Gas charges are from meter at Wildcat Way that services the central plant and should be utilized when buildings are connected to campus steam. City of Ellensburg Tariff G300.						

1.22 Smoke Control

A. CWU prefers buildings without Atriums that would require the implementation of smoke control systems due to the initial cost, generator load, and maintenance. Where the building program or facilities needs dictate the use of an Atrium, obtain permission from the Mechanical HVAC Manager (MHM) and the Capital Planning Project Manager (CPPM)

1.23 Environmental Conditions

A. Wind

1. Facility designs shall consider strong winds with respect to building entrances and air intakes. Wind directions are variable but blows predominantly from the northwest to the southeast.

B. Hoarfrost

1. Mitigations strategies shall be implemented on outside air intakes for 100% outside air systems to prevent frost build up on filters and screens. The campus does not typically have problems on louvers sized for economizer that operate at minimum airflow conditions in the winter.

C. Wildfire Smoke

1. CWU periodically experiences extreme wildfire smoke. Systems shall be designed to over-ride air side economizer in times when the outdoor air quality is unhealth.

2. 100% outside systems should be discussed with the Mechanical Project Manager. The design solutions may consider that a spare set of activated carbon impregnated pleated air filters be furnished as spare product to be inserted in place of the pre-filters during the smoke season.

D. Humidity Controls

1. The conditions in Ellensburg are typically dry and unless required for building programmatic requirements (special laboratory research or rare material preservation), CWU prefers to not have humidification in building systems due maintenance associated with humidification systems.

E. Make-up air and Combustion Air

1. The designers shall consider the cold winter climate.

2. Combustion air louvers open to room will require preheating. Sealed combustion appliances are preferred.

3. Equipment such as dryers with large amounts of make-up require tempered or conditioned make-up air to not impact the room conditions. Unconditioned transfer air from crawl spaces, attics or outdoors is not acceptable.

F. Design Temperatures

1. Buildings shall be designed to maintain indoor design temperatures during the conditions identified in the table below. Exceptions:

   a. Systems with 100% outside air shall have cooling coils selected at 100 degrees ambient. Credit may be taken for heat recovery performance in the cooling coil selection.

   b. Systems with 100% outside air shall not take credit for heat recovery performance in the selection of the heating coils and shall provide full heating upon failure of the heat recovery device.

TEMPERATURE DESIGN CONDITIONS		
Condition	Cooling Mode	Heating Mode
Outdoor Temperatures	95 ˚F db., 68 ˚F wb ASHRAE 0.1% condition	-10 ˚F ASHRAE median of extremes
All spaces unless noted otherwise – Occupied/Unoccupied hours	74°F - 76°F / 80°F – 85°F	68°F - 71°F / 55°F – 60°F
Open/central common spaces (no classrooms/office/labs) such as building entries Occupied/Unoccupied hours	74°F - 78°F / 80°F – 85°F	68°F - 71°F / 55°F – 60°F
Telecom Rooms AV Rooms	75 ˚F	68 ˚F
Equipment Rooms	85-90 ˚F	55 ˚F