

## 1.0 **GENERAL**

### 1.1 **Related UBC Guidelines & Documents**

- .1 Section 20 00 00 Mechanical (and all subsections)
- .2 Section 21 00 00 Fire Suppression (and all subsections)
- .3 Section 22 00 00 Plumbing (and all subsections)
- .4 Section 23 00 00 HVAC (and all subsections)
- .5 All other Tech Guidelines as may be applicable to a given project.

### 1.2 **Related Documents External to UBC**

- .1 BC Plumbing Code and all references contained there within
- .2 BC Building Code and all references contained there within
- .3 Work Safe BC Occupational Health and Safety Regulation

### 1.3 **Description**

- .1 The Guidelines apply to all work completed within buildings on both UBC Vancouver and UBC Okanagan campuses unless stated otherwise.
- .2 In instances where conflicts are found between these guidelines and provincial regulations or codes, please notify UBC Mechanical Engineer.
- .3 These guidelines are intended to be read by designers and their content integrated into construction drawings and specifications. Construction documents are not to reference the technical guidelines directly.
- .4 It is the requirement of the mechanical designer to coordinate these requirements with other disciplines.
- .5 This section of the Technical Guidelines is the parent of Division 21, 22 and 23. All requirements here, apply equally to those sections.

## 2.0 **MATERIAL AND DESIGN REQUIREMENTS**

These are requirements specific to UBC that may not exist in code or other jurisdictions. Any deviation from these guidelines requires a variance be granted.

### 2.1 **Design Requirements**

- .1 All projects shall be subjected to UBC's design review process. Reviews will generally be conducted by representatives from UBC Facilities as well as other stakeholders. Requirements will vary depending on project. Consultants should work with UBC Project Managers to identify key steps.
- .2 All buildings shall utilize district energy
  - .1 This point and all sub-bullets for UBC Vancouver Only: All new and renewed buildings shall utilize district energy as the primary source of external heat opposed to boilers.
    - .1 When heatpump systems are utilized, district energy shall be used for supplemental heat.

- .2 Specifications and design details are to follow those described Section 33 61 00 District Hot Water Energy Distribution. Section 20, 22 and 23 of the UBC Technical Guidelines apply to secondary piping only. Refer to Section 33 for all information on primary side DES piping including installation and piping details.
- .3 Where the district hot water heating system is not yet available to tie into the building, space is to be allowed for the installation of a heat exchanger to provide heat transfer to the building heating system.
- .2 This point and all sub-bullets for UBC Okanagan Only: All new and renewed buildings shall utilize district energy as the primary source of heating and cooling
  - .1 Refer to Section 33 61 00 for all information on primary side DES piping including installation and piping details.
- .3 Wherever specialty systems are being installed (ex solar collectors), coordinate with UBC Facilities during the design stage to ensure that their service requirements can be met.
- .4 Designers shall implement redundant or partially redundant systems when practical. Many buildings may have specific requirements for N+1 redundancy. In less critical applications, such as teaching buildings provide core building infrastructure provide multiple pieces of equipment at 50% each. For example:
  - 2x District energy heat exchangers at 50% each
  - 2x Chillers at 50% each
  - Steam boilers per individual piece of equipment instead of one serving multiple
  - Air Handlers at 50% each

## 2.2 Access Requirements

- .1 Installing piping above ceilings, out of reach of any access panel shall be avoided. Installing valves such that they cannot be reached through an access panel is not acceptable.
- .2 Access panels shall be installed wherever required to access valves, equipment, sensors, etc.
- .3 Any equipment that requires regular access for maintenance shall not be located in a confined space.
- .4 Access to piping chases shall be granted
- .5 Consideration shall be given to accessing, servicing and replacing plumbing fixtures – particularly when they're mounted against tile.
- .6 All manufacturer recommended clearances and service requirements shall be met.
- .7 The designer shall include general notes pertaining to equipment access. If access is not adequate then projects will be responsible for granting adequate service access.
- .8 All rooftop equipment (including fans) shall be accessible for service without the use of ladders. Provide access platforms if required.

- .9 Designs shall consider any rigging requirements. For example, how rigging is to be installed to remove motors, chilled end bells, etc. Where needed, structural members shall be installed for this purpose.
- .10 Avoid placing equipment above communication rooms, freezer farms or other sensitive spaces where the floor will generally be consumed by large equipment which is hard to move. Consider floor mounted equipment in utilitarian spaces such as these as they are easy to access and service.
- .11 Where ladders exceed 16 feet in height or where there is a danger of a worker falling from the ladder to the ground level, roof or floor including an elevated access from a platform having less than 1.2 meters (48 inches) clearance between the ladder and any adjacent guardrail. The cage shall commence not more than 2.2 meters (7 ft.) above grade and continuing at least 90 centimeters (36 inches) above the top landing with openings to permit access by a worker to rest platforms or to the top landing.
- .12 Equipment (including exhaust fans) shall not be placed within 10' of the edge of a roof unless a 3'-6" high guardrail or parapet is in place.
  - .1 Note that TG 07 00 10 requires such full-height guardrails or parapets on all new buildings, so this should only be a common consideration on renovation projects.
- .13 Under no circumstances shall any utility piping extend under buildings as direct buried and in not readily accessible locations. Entire length of utility piping must be readily accessible after project completion. This includes steam, condensate, any gas piping, heating water, cooling water, domestic water, fire protection water, chilled water, and storm and sanitary drainage not related to the building.
- .14 No equipment with regularly scheduled maintenance (i.e. filter changes) shall be located above wood slat ceilings or other integrated ceiling systems (ceilings that feature proprietary panels, clips, etc.) Examples include:
  - .1 Although not preferred, a VAV box, reheat coil or similar may be located above a wood slat ceiling when necessary provided that access panels are provided.
  - .2 A horizontal fancoil or terminal heat pump shall be located in an open ceiling or above t-bar (preferred) or above drywall when absolutely necessary.
- .15 All regularly scheduled maintenance (i.e. filter changes) must be able to be done off a 12' ladder.
  - .1 Although not preferred, a VAV box, reheat coil or similar may be located higher than 12' provided that either:
    - .1 The space is accessible by a scissor lift. If scissor lifts are anticipated for maintenance then coordinate elevator capacity and ensure that a clear pathway to the work area is present without steps.
    - .2 Or there is space to setup a simple vertical scaffold on flat ground. Setting up scaffold above stairs or tiered seating is not acceptable access to mechanical equipment.

- .2 If fancoils or terminal heatpumps serve spaces with high ceilings then they shall be located outside the space in a location where they can be accessed from a ladder and ducted to the space they supply.

### 2.3 Equipment Requirements

- .1 All equipment shall have local support including proof of representation by the same local supplier for a minimum of three years.
- .2 Motors
  - .1 Requirements for variable frequency drives (VFDs):
    - .1 Refer to TG 26 29 23 -2.0.2 for electrical requirements for VFDs
    - .2 Refer to TG 25 00 00 – 7.21 for BMS requirement for VFDs
    - .3 Provide bypass only on critical applications where deemed appropriate by the designer. Avoid bypasses unless they're required.
  - .2 All motors over 1hp shall be MG1 Part 31 Inverter Duty.
  - .3 All motors over 20hp shall have shaft grounding rings.
  - .4 Requirements for electronically commutated motors (ECMs):
    - .1 Minimum BMS Connectivity

BMS Connectivity	Fractional HP ECMs (terminal units, small circulators, etc.)	ECMs > 1hp (air handlers, pumps, etc.)
Motor/drive enable (BO – input into drive from control device) (enables the drive to run, can be used to interlock for safety shut downs)	Required*	Required*
Motor/drive speed (AO – input into drive from control device) (this is a linear representation of the motor speed, 0-100% speed. “pressure or flow” control reset is not acceptable)	Required	Required
Motor/drive alarm (BI – output from drive into control device) (this is a dry contact that represents fault, as defined by the device manufacturer)		Required
Motor/drive status (BI – output from drive into control device) (represents drive is running)	** ***	Required ***
BACnet MS/TP master connection (slave connections are not acceptable) (modbus NOT acceptable) (Modbus to BACnet gateway NOT acceptable)		Preferred

\* May be combined with the speed AO in some cases.  
 \*\* Generally, a status is not required for fractional horsepower ECMs such as fancoils. However, DHW recirc pumps require status, even if they're fractional horsepower.  
 \*\*\* CTs are not recommended for status of an ECM. Due to the high turn down, ECM's which can read their max current draw may not be able to read their minimum current draw accurately. Ensure that a suitable CT or CS is used if you're relying on a 3<sup>rd</sup> party device for status.

- .2 It is not acceptable to use any pre-programmed functions built into ECM controllers (e.g. constant flow, constant pressure, proportional control, etc.) The primary reasons for this is that trouble shooting this controls approach and controlling access is very challenging at a campus wide level and if the controller is ever reset or replaced, it is very likely those settings also will be lost.
  - .3 It is not acceptable to use pumps that require proprietary dongles or remote controls for setup. All settings must be available via local screen.
  - .4 It is not acceptable to use integrated ECM sensors as primary control devices (such as differential pressure sensors built into ECM pumps). However, where possible, these sensors should be available through BACnet for monitoring and optimization.
  - .5 ECMs 3hp or less must use 120/208V or 347/600V. It is preferred that ECMs larger than 3hp also use these voltages, however it is not a requirement at this time.
- .3 Heat exchangers
- .1 This point and all sub-bullets for UBC Vancouver Only: All DES Heat Exchangers
    - .1 Primary side temperatures: 70C EWT, rated for 150C.
  - .2 Brazed Plate Double Wall Heat Exchangers (for domestic hot water energy transfer stations)
    - .1 Rated for potable water service (NSF 372)
    - .2 Double wall design must include air vents and leak detection ports
      - .1 Leak detection via wetting anywhere over the entire exterior surface is not acceptable
    - .3 Plates shall be type 316L stainless steel and they shall be .4mm thick (minimum)
    - .4 Heat exchangers to be specified with removable insulation “blankets”
- .4 Equipment such as boilers, chillers, variable speed drives, air handling units with integral control panels, or unitary HVAC equipment with integral controllers shall be capable of interfacing with UBC’s Building Management System via BACnet protocol. All such equipment shall have IP set in the field (UBC to provide list of instance numbers). UBC is to be provided with all the tools to change the IP instance number in the future should it be required.
- .1 This does not preclude the fact that all central equipment (chillers, boilers, etc.) must have a hardwire BMS connection for enable, reset, alarm and status.
  - .2 See section 25 05 00 – Building Management System (BMS) Design Guidelines.
- .5 5<sup>th</sup> class plants as defined by the BC Boiler and Pressure Vessel act are not acceptable. This means that systems must be divided up to stay under BC Boiler and Pressure Vessel Act cutoffs for steam, refrigeration and hot water.
- .6 [Within the O&M Manual, provide an as-built equipment schedule prepared in spreadsheet format including:](#)

- .1 Equipment type
  - .2 Equipment Tag
  - .3 Manufacturer
  - .4 Model
  - .5 Description
  - .6 Location
  - .7 Other information as may be pertinent
  - .8 Detailed performance information (flows, capacity, etc) are not required in this table.  
This information can be looked up in the shop drawings as needed.
- .7 Within the O&M, provide a filter schedule prepared in spreadsheet format including the below info for all equipment with filters
- .1 Tag
  - .2 Equipment type
  - .3 Location
  - .4 Filter type
  - .5 Filter size(s)
  - .6 Filter quantity

## 2.4 Mechanical Room & Roof Requirements

- .1 Mechanical rooms shall, at a minimum have painted drywall c/w waterproof cove base sealed or integrated into the floor.
- .2 Where mechanical rooms are adjacent to occupied spaces provide special attention to the acoustic concerns; avoid placing critical spaces like offices next to mechanical rooms and consider the use of concrete or block walls which are resistant to moisture and have substantial sound deadening effect.
- .3 Mechanical rooms shall be accessible from the outdoors via double doors.
- .4 Mechanical rooms and roofs shall have keycard access. Coordinate with other disciplines during design phase as needed.
- .5 Floor shall have an elastic membrane coating when mechanical rooms are built over occupied spaces. Refer to TG 09 67 00 Fluid Applied Flooring for more information.
- .6 Designs shall minimize the mechanical equipment, which is installed exposed on rooftops, and ensure that all equipment installed on rooftops is suitable for outdoor installation:
  - .1 All buildings with a high density of rooftop mechanical equipment shall have fully enclosed mechanical penthouses to contain all air handlers, pumps, tanks, boilers, chillers, etc. and where practical exhaust fans and mixing box's.
  - .2 Exposed piping on rooftops should only include low point drains, high point air vents and manual isolation valves with valve stem extensions. Where additional piping accessories are required, a heated valve house shall be constructed. All pipes and electrical connections shall rise into this room and penetrate to the roof horizontally. All pumps, control valves, temperature sensors, strainers, etc. shall be installed in this room.

- .3 The designer may determine how to execute this concept including putting it on the side of an elevator overrun, as a freestanding structure, built into custom air handling equipment or other concepts that maintain the same design intent.
- .4 In situations where a “valve house” is not deemed necessary, insulated heating and cooling pipes shall not penetrate rooftops vertically with just a sleeve installed. A proper “dog house” shall be installed. This “dog house” shall have an overhang.
  - .1 Isolation valves may be installed under the overhang of the “dog house” provided that they have valve stem extensions so that the insulation is only minimally compromised.
- .5 Small diameter pipes such as refrigerant pipes and gas pipes may penetrate the roof through a gooseneck provided that the gooseneck is counter flashed into the roof and that the gooseneck is sealed to prevent insects, rodents and birds from entering the building through these penetrations.
  - .1 Where applicable consideration must be given to oil return and/or airlocks forming in goosenecks.
- .6 Plumbing vents flashed into the roof with a spun aluminum cap that overlaps the roof penetration or similar flashing are acceptable.
- .7 Exposed duct runs shall be minimized. Where they are used, structural steel supports integrated into the roof are required, the ductwork shall be insulated and clad with appropriate waterproof cladding (plated sheet metal shall not be exposed) and ductwork layout shall not impede access to equipment. Use of numerous ships ladders to go over ductwork does not constitute reasonable access.
- .8 See link here for 2018 memo which includes more details on this item:  
[https://www.technicalguidelines.ubc.ca/files/Div20/Roof\\_Memo\\_Apr2018.pdf](https://www.technicalguidelines.ubc.ca/files/Div20/Roof_Memo_Apr2018.pdf)

## 2.5 Construction Requirements

- .1 Where pipes penetrate through floor slabs they must be sleeved with a pipe that protrudes a minimum of 2" (50 mm) proud of the floor or a small housekeeping pad installed to prevent flooding to the floor below.
  - .1 Where riser clamps are used, an appropriate detail must be used such that the riser clamps do not sit on the sleeves.
- .2 All exposed materials prone to rusting (equipment supports, cut ends of unistrut, fasteners, exposed pipe sleeves, etc.). Shall be coated with rust inhibiting paint.
- .3 Insulation on piping or equipment shall be installed such that all factory or field installed labels remain visible.
  - .1 All piping shall have computer generated labels. Preference is to stack the lettering and display the full word description of the piping (i.e. “Domestic Hot Water”, not “DHW” or “District Hot Water”, not “DHW” or “Domestic Cold Water”, not “DCW”)
  - .2 All pipes that are accessible must be labelled every 10m and where they enter and leave rooms.
- .4 Pipe all equipment drains to floor drains.
  - .1 See plumbing fixture section for additional requirements.

- .5 All base mounted equipment shall sit on housekeeping pads, minimum 2" high and 4" wider than the equipment.
- .6 Cleaning
  - .1 Refer to 01 77 00 for further information
  - .2 Specify cleaning of interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.
  - .3 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.
  - .4 Specify new filters at turn-over, clean switch gear and VSD serving mechanical equipment inside and out.
  - .5 Specify removal of construction debris from the mechanical/electrical rooms.
- .7 No mechanical equipment or services shall reside in or pass through an electrical room or communications room unless they directly serve that room.

## 2.6 Demolition Requirements

- .1 Decommissioned equipment shall be demolished and disposed of in accordance with applicable codes and standards. No equipment shall be abandoned.
- .2 Where pressure vessels are decommissioned or abandoned, the contractor shall supply UBC Facilities with a photo of all labels on the equipment including the TSBC (previously BCSA) registration decal. The contractor shall also drill a hole in the equipment prior to disposal and shall confirm in writing to UBC Facilities that this has been done. This is so that we can cancel the operating permit for this equipment and stop paying the annual fees associated with it.
- .3 Decommissioned piping and ducts located within mechanical rooms shall be demolished and cut back to the edge of the mechanical space, capped and clearly tagged. No piping shall be abandoned within mechanical rooms.
- .4 Decommissioned piping may be abandoned outside of mechanical rooms to the designer's judgement. Pipes which are likely to be obtrusive to future use of the space or maintenance should be demolished. Abandoned pipes are to be clearly labelled as such – at least once per room and more regularly as required.
- .5 All dead legs shall be capped and disconnected as close as possible to the active pipe. Valves shall not be considered acceptable isolation from a dead leg. The dead leg piping/equipment shall be demolished as per the requirements above.

## 2.7 Water Feature Requirements

- .1 All ponds shall utilize standard building components that maintenance crews are familiar with servicing. Avoid the use of specialty pond manufacturers for components such as pumps.

- .2 All ponds shall be controlled by a standard BMS Controller by one of UBC's approved providers. A graphic shall be constructed for the pond that is remotely accessible through UBC's BMS system.

## **2.8 Miscellaneous Requirements**

- .1 Provide one set of special tools including computer hardware and software required to service equipment as recommended by manufacturers and in accordance with Section 01 77 00 Closeout Procedures.
- .2 Connections into existing systems to be made at time approved by owner. Request written approval of time when connections can be made.

## **3.0 LESSONS LEARNED & COMMON MISSES ON UBC PROJECTS**

Items in this section are not specific requirements of UBC but are code or industry best practices which have been missed on past jobs. These items should be considered in mechanical designs at UBC. However, if they're not applicable then a variance is not required.

- .1 All pipe penetrations through fire rated walls must have appropriate firestop listing
  - .1 If the pipe is subject to movement (thermal expansion, vibration, etc.) then the listing must accommodate the pipe movement
  - .2 If the piping has the potential to condense on the outside then the listing must make accommodations to maintain the insulation and vapour barrier

**\*\*\*END OF SECTION\*\*\***