Hydronic Heating: Hydronic heating is the preferred heating system for campus buildings. Steam shall not be used as a direct source of heating for an HVAC system. It shall be used in conjunction with a heat exchanger to heat fluid within a hydronic heat transfer system. Thus, the use of steam heating coils, unit heaters, cabinet unit heaters, convectors, finned-tube elements, etc. is not allowed. Exception: In areas within existing buildings where only steam heat is available and it is impractical to provide a hydronic system, steam heating equipment may be used upon approval by FMP Engineering.

Heating Source Equipment: Campus Steam (if available) shall typically be used to provide the heat source for campus buildings. If Campus Steam is not available, designer shall coordinate the selection of source heat equipment with FMP Engineering.

Hydronic Heating End Use Equipment Sizing: All end use equipment (i.e., fintubes, reheats, preheat coils, etc.) shall be sized to operate with 140 Deg F water or less.

Terminal Zoning: As reflected in the paragraph entitled *Terminal Zoning* within the *HVAC Systems* section within these *Design Guidelines,* heating systems shall be configured such that each occupied space can be controlled as a separate temperature zone. Furthermore, the heating unit(s) serving each building entrance shall also be configured as a separate temperature zone.

Terminal Unit Pipe Sizing: The minimum run out pipe size to terminal units (i.e., reheat coils, fintubes unit heaters, etc.) shall be ¾"

Perimeter Heating: Each occupied space with an exterior exposure that includes a high percentage of window area shall incorporate hydronic perimeter heating unit(s). Heating units shall be strategically located adjacent to areas of greatest heat loss. Exceptions to this requirement for perimeter heating will be considered on a case by case basis.

Public Entrances: One or more cabinet unit heaters shall be provided at each public entrance. At larger, high traffic entrances one heater shall be provided at each side of the entrance. These units shall be floor supported or wall mounted. They may be either recessed or surface mounted. They shall not be installed overhead. It is important to generously size these units.

Non-Public Entrances: The installation of cabinet unit heaters is not specifically required at low-traffic entrances. However, hydronic heating of some form (e.g. finned tube, convectors) will typically be needed.

Loading Docks: High capacity unit heaters and/or heated air curtains shall be provided at loading docks and other high infiltration service areas. It is important to generously size these units.

Separate Hydronic Heating Systems: The number of separate hydronic systems shall be coordinated with UNL FMP Engineering during schematic design. Hydronic systems serving preheat equipment shall be filled with inhibited 40% propylene glycol solution. Our preference is that hydronic systems serving terminal unit systems be filled with inhibited water (no glycol).

Hydronic Heating System Connections at 100% Outdoor Air Systems: Hydronic system connections at preheat coils in 100% dedicated outdoor air units shall be equipped with dedicated circulation pump and three-way valve. *See Design Detail 23 21 02 – 01, Pumped PreHeat Water Coil Piping Schematic* in these *Design Guidelines.* This arrangement provides constant flow through coils to prevent coil hot/cold spots and freeze-ups but still exhibits variable flow behavior to the rest of the system in order to conserve pumping energy.

Constant vs. Variable Flow Systems: All hydronic heating systems shall be variable flow type and shall utilize two-way control valves exclusively at all central station and terminal units. Each pump motor in a variable flow system shall be served by a variable frequency drive (VFD).

Reverse vs. Direct Return: A reverse return piping configuration is desirable but not required for hydronic systems that serve multiple terminal units. Direct return configuration is also acceptable given that it is typically more cost effective and practical. When direct return systems are used, it is preferred that risers, mains and main branches be "oversized" (i.e. generously sized) so as to yield a system that is somewhat self-balancing.

Pressure Independent Control Valves: We are currently evaluating the use of these on all hydronic terminal units and air handling units. At this time, coordinate the use of these with FMP Engineering.

Automatic Balancing Valves: An automatic balancing valve shall be installed on all hydronic heating terminal units including unit heaters, cabinet unit heaters, reheat coils, fintube radiation, etc. without exception. Such devices shall also be installed on hydronic air handling unit coils unless a pressure independent control valve is provided.

Pumps: Centrifugal pumps that incorporate motors that are 2 HP or less may be of the close-coupled in-line type. Pumps that incorporate motors that are 3 HP or larger shall be of the base mounted type. Accessibility shall be such that the rotating assembly can be removed from the pump without removing the pump casing from the piping. Vertical split-coupled in-line pumps may be used in lieu of base mounted end-suction pumps as long as they are located in an accessible area near floor level. Horizontal split case pumps shall be used for applications with inlet connections greater than 4".

Specify suction diffusers on the inlet of all base mounted pumps (or show and note a minimum of 10 pipe diameters of straight pipe). **Do not** specify "triple-duty" type check/throttling/shut-off valves. Instead, provide separate check, balance and shut-off valves.

Backup Equipment: A 100% backup or duplex unit shall be provided for each truly critical piece of hydronic heating that is vulnerable to failure (e.g. boilers, heat exchangers, pumps, etc.). When a hot water heat exchanger serves a combined perimeter/preheat/reheat system it shall be viewed as critical, requiring backup with a second heat exchanger.

Expansion Tank: A replaceable bladder type expansion tank shall be provided in each hot water heating system. See *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic.*

Air/Dirt Separator: An in-line coalescing air/dirt separator shall be provided in each hydronic system. See *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic.*

Chemical Pot Feeder: Each hydronic heating system shall incorporate a bypass pot feeder See *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic.*

Bypass Filter: Each hydronic heating system shall incorporate a bypass bag filter. See *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic. .*

Fill Connection: Provision for adding fluid to each closed loop hydronic system shall be provided as shown in *Drawing 23 21 00-2, Heating Hot Water System Piping Schematic.*

Elastomers: Devices that incorporate elastomers that are vulnerable to hardening, cracking and leaking with age shall not be installed in hydronic systems. This includes certain dielectric fittings, bolt-on saddle tap type pipe connectors and specific rubber gaskets (e.g. "red rubber gaskets").