**Hydronic System:** For the purposes of this writing a *hydronic* system is defined as a water-based heat transfer system, excluding steam. It is acknowledged that steam is often included within the hydronic category.

**Separate Systems:** Two independent hot water heating systems shall be provided in each building. One shall serve perimeter heating units and AHU preheat coils. The other shall serve reheat coils. Each system shall incorporate a dedicated heat exchanger and duplex pumps along with other standard system components such as expansion tank, air/dirt separator and bypass filter. A dedicated controller along with dedicated static and differential pressure transmitters shall be provided for each system. The perimeter/preheat system shall be filled with inhibited ethylene glycol solution. Glycol content shall be 30% by volume. The reheat system shall be filled with inhibited water. Providing separate systems allows (1) redundant heat sources within the building to provide heat during system maintenance (2) redundant heat sources to prevent freezing during system failure (2) optimized temperature set point for each system (3) positive shut-off of the perimeter/preheat system during building cooling mode operation (4)

**Constant vs. Variable Flow Systems:** All hydronic heating/cooling systems shall be variable flow type and shall utilize two-way control valves exclusively at all central station and terminal units. Exception: A primary system serving a chiller (i.e. either a primary only system or the primary portion of a primary/secondary system) shall be configured for constant flow. Each pump motor in each variable flow system shall be served by a variable frequency drive (VFD). A three-way control valve shall not be installed within a variable flow system for any reason, not even to prevent a potential no-flow condition or to maintain continual circulation throughout the entire system.

**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.

**Continuous Circulation:** A measure of continuous circulation shall be maintained in variable flow hydronic heating systems. A no-flow condition shall be prevented. In the past it was deemed necessary to maintain continuous flow for at least two reasons: 1) to protect the system pump motor from overheating at low speed operation and 2) to support a perceived need for hot water to be available instantaneously upon demand at all heating units throughout the system. In regard to motor overheating: Due to the increased turn-down capability of today’s VFD-approved motors (at least 10 to 1), minimal heat is generated at low flow conditions and thus it is deemed unnecessary to ensure such flow. In regard to the availability of hot water upon demand: In HVAC heating systems, loads typically change slowly and thus quick response is not required. So why is continuous circulation needed?...to ensure adequate flow of hot water for proper sensing of temperature in the supply piping located downstream of the heat exchanger. The required circulation shall be maintained by providing a manual balance valve in bypass configuration between hot water supply and return piping at a location near the system differential pressure transmitter. The valve shall be adjusted to provide adequate flow across the temperature sensor not to exceed 5% of the total system design flow rate.

**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. This represents a change from previous standards. The goal is to limit the size of in-line pumps such that they can be removed and replaced by an individual working off of a ladder. 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”.

**Pressure Control:** See paragraph entitled Pressure Differential / Fill Pressure Control within the Energy Management, Building Automation Systems section within these General Guidelines.

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

**Backup Equipment:** A 100% backup or duplex unit shall be provided for each truly critical piece of hydronic heating or cooling equipment that is vulnerable to failure (e.g. chillers, boilers, heat exchangers, pumps, etc.). When a hot water heat exchanger serves only one of two heating systems (i.e. a perimeter/preheat system or a reheat system) it may be viewed as a non-critical unit that requires no backup. If it serves a single combined perimeter/preheat/reheat system it shall be viewed as critical, requiring backup.

**Expansion Tank:** A replaceable bladder type expansion tank shall be provided in each hot water heating and each chilled water cooling system. See Drawing 23 21 00-1, Flow Diagram – Hot Water Heating System.

**Air/Dirt Separator:** An in-line coalescing air/dirt separator shall be provided in each hydronic system. The University has recently embraced this as a standard requirement given that poor water quality in hot water heating systems has become a serious problem. See Drawing 23 21 00-1, Flow Diagram – Hot Water Heating System.

**Bypass Filter:** Each hot water heating system shall incorporate a bypass bag filter. This requirement is driven by water quality problems. See Drawing 23 21 00-1, Flow Diagram – Hot Water Heating System.

**Fill Connection:** Provision for adding fluid to each closed loop hydronic system shall be provided as shown in Drawing 23 21 00-1, Flow Diagram – Hot Water Heating System. A permanent fill unit shall not be provided. A portable fill unit with integral air gap shall be provided for this purpose.

**Freeze Protection:** Hydronic piping systems that contain no antifreeze solution (and never will) shall not be installed in locations that present vulnerability to freezing conditions (e.g. outdoors without sufficient earth cover, within unheated spaces, within building exterior walls or wall cavities, within exposed overhangs, within exposed exterior walkways, etc.) Hydronic systems that incorporate components that are likely to be exposed to freezing conditions (e.g. preheat coils, heating equipment outdoor chillers, etc.) shall be filled with antifreeze solution. Antifreeze solution shall never be used in any chilled water system that is served by the campus central chilled water system. The system fluid in each hydronic heating or cooling system, whether water or antifreeze solution, shall contain corrosion inhibitors appropriate for protecting components within that specific system.

**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”). Many leaks have developed within hydronic systems across campus over the years as elastomers within these devices hardened and cracked with age.

**Dielectric Fittings:** Separation of copper and ferrous piping within a hydronic heating /cooling system shall not be accomplished by installing standard dielectric fittings. However, “Clearfow” dielectric fittings may be used. Such fittings incorporate a
thermoplastic liner that allows no contact between system fluid and metal components. Brass fittings, bronze fittings and bronze body valves may also be used to separate copper and steel piping.