Distribution System: As stated in the *Steam Distribution System* section within these *General Guidelines* steam is distributed to campus buildings via two distinct piping systems. These are referred to as the "*Campus Steam*" system (medium pressure) and the *High Pressure Steam* system. Distributed steam is available year-round through each system. Where available, Campus Pressure steam shall be used for building heating. High pressure steam shall typically be reserved for specialty service such as laboratory sterilizers, animal cage washers and kitchen cleaning equipment. However, it shall be used for building heating in areas beyond the reach of the Campus Pressure system.

Building System: By definition, the building steam system consists of all steam piping and components on the "building side" of the steam supply and pumped condensate building isolation valves. As stated in the *Steam Distribution Systems* section within these *General Guidelines*, the building isolation valves themselves shall be considered components of the steam/condensate distribution system as if they were located within the tunnel system and shall be specified/selected accordingly For example, steam valves shall be higher quality with welded connections rather than lower quality flanged valves that would typically be utilized in a building steam system.

Compliance: Building steam systems shall comply with *ASME B31.9 – Building Services Piping.*

Service Entrance: See the *Steam Distribution Systems* section within these *General Guidelines* for requirements regarding steam and condensate service entrances for buildings served by the central steam distribution system.

Pressure Regulating Station: Within each building, a separate pressure regulating (PRV) station and distribution system shall be provided for each distinct steam operating pressure requirement. Air heating coils and heat exchangers (convertors) for hot water heating are typically served by a common pressure regulating station that provides steam at 10-15 PSIG. Although no longer installed in new construction, perimeter heating systems that utilize steam directly shall be served by a dedicated steam distribution system within the building with a pressure regulating station that provides steam at approximately 5 PSIG. Each process steam system that requires higher pressure steam shall be served by a dedicated regulator fed directly from the high pressure central distribution system.

PRV Exception: In some cases the installation of a pressure regulating station in a building heating system steam feed from the medium pressure "Campus Steam" system may be deemed non-essential. Such determination is based upon three factors: the average steam pressure delivered to the building, the constancy of the steam pressure and the ability of the control system(s) to function adequately with variable steam inlet pressures. If the pressure regulating station is to be deleted it is essential that the optimal number, type and size of control valve(s) be used to ensure adequate turn-down for good control and that control system tuning be optimized. A system design that incorporates a pressure regulating station is the default design. Deletion of the regulating station is allowed only when specifically approved by *F&S Utilities and Energy Services Division.* Note: Provision of a PRV in a high pressure feed to a building is always required. This applies to high pressure building heating steam, such as is the case on North Campus. It also applies to smaller high pressure feeds to buildings across campus that serve laboratories, kitchen/dining facilities and other process loads.

Relief Valve: As is typically required, an appropriately sized and selected relief valve shall be provided immediately downstream of each PRV or PRV station. The pressure setting for each relief valve shall be low enough to provide required protection for system components but shall be adequate to prevent nuisance discharges of steam throughout the full range of normal operating conditions. For example, a relief valve serving a 10-15 PSIG heating system shall typically have a setpoint of 20-25 PSIG when serving vulnerable components such

as cast iron radiators. Regardless of pressure or service an adequately sized relief vent line shall be extended to the top of the building and configured to discharge vertically at an elevation that is, at a minimum, 7 ft. above the adjacent roof line. No steam relief vent shall discharge into a location within a building, area well or equivalent. No vent shall discharge at a location or in a direction that poses a potential hazard to the public or maintenance personnel. Any variance to this stringent requirement requires approval of Owner.

Relief Valve Exception: For building heating systems served by the medium pressure "Campus Steam" distribution system…If a building steam system, including all devices and steam traps, is designed to safely handle exposure to "worst case" steam distribution pressure, the relief valve and vent are not required. As stated in the *Steam Distribution Systems* section within these *General Guidelines*, the design pressure for the medium pressure system (aka "Campus Steam" system) with all its components is 125 PSIG nominal. This represents the highest pressure to which the building steam systems can potentially be exposed. Pressure rating of pipe and fittings in building steam systems fed with "Campus Pressure" steam is typically not a concern. Class 125 cast iron components are rated for 150 PSIG at 350 degrees F. However pressure/temperature rating of individual components such as humidifiers, domestic water heaters, kitchen equipment, laboratory equipment and other process equipment require evaluation. As required, such devices shall be protected by dedicated PRVs with safety relief valves piped to appropriate safe locations. A system design that incorporates a building relief valve is the default design. Deletion of the building relief valve station, as outlined above, is allowed only when specifically approved *by F&S Utilities and Energy Services.* Note: Deletion of a relief valve within a building high pressure steam system is not allowed.

Automatic Isolation: An automatic isolation feature shall be provided for each direct steam perimeter heating system to allow the steam service to be completely shut off during periods when heating is not required.

Condensate Return Systems: Each steam supply system with a distinct operating pressure shall be served by a dedicated gravity condensate return piping system. Each perimeter heating system that utilizes steam directly at individual heating units shall be served by a vacuum return system if possible. All condensate return piping, including vacuum return piping, shall be continually pitched in the direction of flow with no rises in elevation (with few exceptions, such as drip trap discharge lines). The condensate from all gravity return systems within a building shall be returned to one or more vented receivers.

An adequately sized vent line shall be extended to the top of the building and configured to vent flash steam to atmosphere in a safe manner. It shall be terminated in a manner that prevents the entrance of birds and debris. Vent lines shall be generously sized to prevent pressurization of the receiver when steam traps blow thorough. Condensate from high-pressure (i.e. greater than 15 PSIG) steam systems/equipment shall pass through a flash tank prior to being returned to a common receiver along with condensate from low-pressure systems.

Condensate Pumping Unit: All condensate from building steam systems that are served by the central steam distribution system shall be collected and pumped back into the central (tunnel) condensate return system. Typically, condensate pumps shall be electric motor driven. However, it may be more appropriate to use steam-powered condensate pumps in applications that involve especially high condensate temperature, a hot/humid environment, non-availability of electricity and/or physical space limitations. Of course, steam powered pumps require the availability of high pressure steam for operation, which is available in a limited number or locations. Pumping condensate with an electric motor driven pump unit is demanding intermittent service. Thus, pump discharge check valves shall be severe duty type in lieu of

standard duty check valves. Standard check valves will not hold up in this service. It is also essential to provide a properly selected balancing valve in the discharge line at each pump to prevent cavitation and maintain stable, efficient operation. We have found that a pressure independent flow-limiting valve is ideal for this service.

Condensate Metering: Condensate shall be metered within each building prior to entering the central (tunnel) condensate return system. It is typically preferred that only one metering station be installed per building. It is not necessary to meter low, medium and high pressure condensate separately. In order to maintain accurate metering, it is essential that there is no backflow of condensate through building condensate pumps. Thus, the requirement for robust check valves.

Steam Metering: As of the time of this writing, steam is not being metered at campus buildings. Rather, steam metering is accomplished indirectly via use of steam condensate meters. The use of direct steam metering has been avoided in the past for three reasons: cost, difficulty in achieving an installation with adequate straight run of piping and unavailability of meters with adequate turn-down capability.

Insulation: All hot surfaces of steam and condensate piping systems and related equipment, with the exception of steam traps and condensate pump volutes, shall be insulated. The common practice of leaving unions, strainers, pressure regulating valves, control valves, and various specialties uninsulated is disallowed. Also disallowed is the practice of leaving condensate receiver tanks and adjacent condensate return piping uninsulated**.**