

CHILLED WATER DISTRIBUTION SYSTEM

Campus-Wide System: A campus-wide central chilled water system has been developed in recent years and is being expanded to serve additional cooling loads as need arises and opportunity affords. This system is superior to other smaller cooling systems in that it provides highly reliable chilled water service on a continuous year-round basis. It is the intent of long range planning to develop and extend this system to serve as many buildings as practical. The system is configured as a single networked distribution piping system served by five individual chiller plants in conjunction with a large stratified liquid thermal storage tank located at the far southwest corner of campus. The five plants (and relative locations) are as follows: the Oak Street Chiller Plant (southwest), the North Campus Chiller Plant (north central), the Library Air Conditioning Center (central), the Animal Sciences Air Conditioning Center (central) and the Chemistry & Life Sciences Chiller Plant (east central). Due to the remote location of the veterinary medicine campus, the chiller plant and associated distribution system that currently serve it will continue to operate independently as a satellite system for the foreseeable future.

Compatibility: With this long-range plan in mind, it is important that all chilled water-cooling systems in new and remodeled buildings within the future geographical reach of the campus-wide system be designed such that they are compatible with this system. This system is a variable flow, "high delta T" system with distribution pumping located within the chiller plants. Distribution system design dictates that no pumps be located within individual buildings, with the possible exception of a minimal number of booster pumps located within "high head" buildings.

Energy Management System: In simplified terms, operation of the pumps within the chiller plants is controlled via pressure differential feedback from connected buildings through the campus-wide EMS. The system fill pressure is controlled via static pressure feedback from connected buildings, also through the campus-wide EMS. To accommodate this, a pressure differential transmitter shall be piped across the supply and return piping at

a location near the most hydraulically remote coil in each building and tied into the building EMS. Also, a pressure transmitter shall be piped into the return piping at or near the highest point in each building system and tied into the building EMS.

Distribution Piping: Distribution piping shall be direct-buried with a typical cover depth of 5'. A minimum cover of 3' is allowed when circumstances dictate. All distribution piping shall be sized and configured as appropriate to serve the ultimate future cooling loads in the geographical area being served. Isolation valves shall be installed in mains adjacent to each major branch and in all branch piping. Branch valves should be located as near the mains as possible but shall not be located beneath streets. A manual air vent shall be installed at each high point. A manual blow-off/drain shall be installed at each regional low point in main distribution piping but is not required at each and every low point in main and branch piping. The installation of chilled water distribution piping within steam tunnels shall generally be avoided. Although the cooling systems within buildings are to be designed for a chilled water temperature differential of 16 degrees F minimum, distribution piping shall be conservatively sized for an average temperature differential of 12 degrees F maximum.

AHU/Coil/Valve Design: As stated within the *Building Cooling Systems* section within these *General Guidelines*, the design of each cooling coil connected to this system shall be based upon an entering water temperature 43 degrees F and a minimum leaving water temperature of 59 degrees F. Each cooling unit shall maintain this 16 degree F minimum design temperature differential at all load/operating conditions. Each unit shall also be designed with all of the features that are needed for adequate freeze protection of its chilled water coil(s) without the use of antifreeze solution in the chilled water system or the necessity of isolating and draining coils. Each new chilled water control valve shall be of the two-way type and shall have an appropriate static pressure rating, close-off pressure rating and dynamic pressure rating for this somewhat demanding application. The use

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of pressure independent control valves is encouraged, especially at larger chilled water coils. Their use results in higher and more consistent chilled water "delta T" which benefits the larger system in multiple ways.

Service Entrance: Other requirements for a new or remodeled building system for achieving compatibility with the campus-wide system include the following work to be accomplished at the chilled water service entrance within each building (see *Drawing 23 09 13-3, Central Chilled Water System Metering Station Detail* and *Drawing 23 20 00-1, Central Chilled Water System Building Service Entrance Detail* for detailed requirements):

1. Installation of dedicated wall penetration pipe sections ("spools") that include interior drains and vents.
2. Installation of a BTU metering / pressure regulating station with EMS monitoring and flow control capabilities.

The service entrance piping and BTU metering / pressure regulating station shall be sized with appropriate consideration given to the building's potential future cooling load. For buildings with below-grade basements, piping shall be brought into the building through penetrations in the basement wall. For buildings that are built with slab-on-grade construction or with inadequate basement depths, a generously sized pit with a floor drain shall be provided to facilitate accessible pipe entrance. Provision for thermal expansion of system fluid will be accomplished at the chiller plant(s); therefore expansion tanks shall not be installed within any connected buildings.

Building System Conversion: In order for an existing building (or portion thereof) to be provided with cooling from the central system, its internal chilled water system(s) must first be made fully compatible. In addition to the items addressed above in the paragraph entitled *Service Entrance*, conversion of an existing building's chilled water system(s) to achieve compatibility shall also include the following as applicable:

1. Removal of any antifreeze solution from the system accompanied by a thorough system cleaning.
2. Resolution of any resulting freeze protection issues at cooling coils within

air handling units, making modifications as required. These modifications will be substantial in many cases and may include the reconfiguring of air handling units and/or ductwork to improve air mixing, the upgrading of dampers and controls and the installation of air blending devices. In each case, special freeze protection controls shall be provided at each cooling coil. These controls shall automatically open the control valve to cause flow through the coil as freezing conditions are approached.

3. Replacement of any three-way control valves and/or inappropriate two-way control valves at cooling coils with appropriate two-way valves and modification of piping as appropriate.
4. Replacement of existing isolation and balancing valves as appropriate.
5. Cleaning or replacement of condensate drain traps and piping systems serving chilled water coil drain pans to ensure adequate condensate removal.
6. Upgrading of pipe/valve insulation as required.
7. Removal of abandoned chillers, cooling towers, pump(s), expansion tank(s) air separator(s), etc. along with any associated piping, electrical power and control wiring, conduit and devices, and pneumatic control tubing and devices as appropriate.

Glycol: No cooling coil served by the central system shall at any time be flushed or filled with glycol antifreeze solution. Freeze protection shall be provided in a different manner (such as by draining and drying with ventilation system air or draining and blowing out with compressed air). Use of glycol solution presents too high a risk of contaminating the central system.

Temperature/Pressure: Building chilled water system design shall typically be based upon the delivery of 43 degree F supply water to the building service entrance at a supply/return differential pressure of 25 PSI minimum.

Veterinary Medicine Complex: It is noted that some of the system description and requirements addressed above are not fully applicable to the central chilled water

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system at the Veterinary Medicine complex. The Owner shall be contacted to establish the limits of applicability for each cooling system/component to be served by this system.

Chilled Water Capacity Charge: In order to receive central chilled water service a project or campus unit is required to pay a one-time "Capacity Charge" fee. This applies to the central system at the veterinary medicine complex as well as the campus-wide central chilled water system. A written policy has been prepared to formalize and clarify the assessment of this fee. A standardized form has also been prepared to facilitate fee assessment. These documents are available in electronic format.

Incentive: The formula used for calculating the Capacity Charge fee incorporates a fee reduction or "credit" for projects with chilled water systems that exceed the 16 degrees F delta T minimum requirement. Conversely, it incorporates an up-charge or "penalty" for those that fall short of this minimum requirement. Thus, a financial incentive to increase chilled water delta T is provided.

Utility Program Statement: Actual pressures within the campus-wide system at a given building/site at any given time are dependent upon many factors. Information related to available plant and distribution system capacities, system pressures and confirmation of system temperature that are to be used for design purposes shall be obtained from the Owner via a *Utility Program Statement*. Other specific design information including placement and sizing of system extensions shall be obtained in the same manner.