NC State University Design and Construction Guidelines
Division 23 Chilled Water System

1.0 Purpose

A. The chilled water system at NC State University consists of combinations of series loops, primary/secondary/tertiary loops and stand alone building chillers. The ultimate goal is a centralized district cooling system(s) utilizing a primary/secondary/tertiary configuration. This guideline will assist the designer in designing a building system that shall connect to a district cooling system.

2.0 General Requirements

A. The building system shall function as a variable flow constant temperature rise system over the entire load range for all seasons.

B. Central chilled water is operated year round with a supply target temperature of 42º F. Each building shall connect to the central chilled water loop.

C. Each building shall use a variable volume, variable head pumping system. Each building shall include as a minimum: cutoff valves, temperature and pressure gauges, system drains, and metering.

D. Design pressure for all components shall be at least 250 psig at 100° F

E. All system drains shall be piped to sanitary sewer. A brass hose adapter, cap and chain shall be provided on all vents and drains

F. Process loop cooling shall be provided though heat exchanges resulting in a closed loop system.

3.0 Equipment

A. Coils

1. Chilled water coils shall be selected on the basis of 44° F entering water temperature and 58° F leaving water temperature. Minimum tube velocity shall be four (4) fps at full load condition. Coils shall maintain a 14° Δ T from 100% load down to 25 % part load.
2. All coils shall be a minimum of six (6)row construction and a maximum of eight (8)row construction. All coils shall be constructed to facilitate cleaning. Access shall be provided on both sides of the coil.

3. Chilled water coil control valves shall be two-way, normally closed. Provide variable flow loop for the building or process loop. Control valves and operators shall be selected for the full possible pump head on the loop.
4. All coils shall have non-ferrous headers and tubing.

B. Building Pumps

1. Building loops shall be variable volume loops. Variable frequency drives for building pumps shall be provided.
2. The building chilled water pump and head shall be selected with a reasonable engineering factor for strainer plugging and future pipe roughness and flow. Pumps shall be selected in the mid-points of their curves. Provision of extra flow capacity is acceptable
3. A redundant pumping system is required.

C. Chilled Water Piping System

1. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
   a) ASTM, B 88, Type L, drawn-temper copper tubing, ASME B16.22, wrought-copper fittings, and soldered joints.
   b) Schedule 40 steel pipe; Class 150, malleable-iron fittings; and threaded joints.
2. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
   a) ASTM B 88, Type L drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
   b) Schedule 40 steel pipe, forged-steel flanges and flange fittings, and welded and flanged joints.
      (1) Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
      (2) Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
         (a) Material Group: 1.1.
         (b) End Connections: Butt welding.
         (c) Facings: Raised face.

4.0 Installation

A. System Pressure and Leak Test

1. Test shall be a minimum of four (4) hours. Contractor shall have conducted a preliminary pressure test prior to final acceptance test and shall correct any pipe leaks prior to final test.
2. Chilled water piping shall be leakage rate tested. Leakage rate test shall be conducted at the same time as the hydrostatic pressure test.
3. The maximum allowable leakage is determined by the following formula:

   L= N*D*(P) / 7,400

   where:

   L = allowable leakage (GPH)

   N = number of joints in length of pipe line tested

   D = nominal pipe diameter (inches)

   P = average test pressure during leakage test (psig)
4. Perform the system tests in accordance with ASME B31.9 requirements.
   a) Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   b) While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   c) Isolate expansion tanks and determine that hydronic system is full of water.
   d) Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
   e) After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
5. If measured leakage rate exceeds maximum leakage rate, repair with new materials and repeat test until satisfactory results are obtained