15535 Chilled Water System

Part 1: General

1.01 The chilled water systems at NC State University consist of combinations of series loops, primary/secondary/tertiary loops and stand alone building chillers. It is the University's long range plan to eliminate these distributed generation systems and progress towards a centralized district cooling system(s) utilizing a primary/secondary/tertiary configuration. This guideline is intended to assist the designer in designing a new or renovated building system that will be compatible with future connection to a district cooling system.

1.02 The designer of a new or renovated building system should coordinate with the staff of Facilities Planning and Design for the particulars of the specific chilled water loop in the vicinity of the project under design. The particular project location will determine if the project will provide a building chiller or connect to an existing chilled water loop for the interim period until the district system is completed.

1.03 Central chilled water will be operated year round with a supply temperature of 42 °F. Each building will connect to the central chilled water loop either with or without its own chiller.

1.04 Each building will use a variable volume, variable head pumping system. For buildings not requiring 100% outside air, the building shall use return water temperature control set initially at 54 °F to provide a minimum ? T of 12°F.

Part 2: Design Guidelines

2.01 General

- The designer's goal should be to design a building system that can function as closely as possible as a variable flow constant temperature rise system over the entire load range for all seasons.
- Design pressure for all components should be at least 250 psig at 100° F.
- Pipe all system drains to sanitary sewer. Provide brass hose adapter, cap and chain on all vents and drains.

2.02 Coils

- All 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 4 fps at full load condition. Select coils to maintain a 14 ° ? T from 100% load down to 25 % part load.
- All coils shall be of minimum six row construction. Air flow and water flow shall be piped in a counterflow arrangement.
- Specify two way control valves for all coils and provide variable flow loop for the building or process loop. All control valves and operators shall be selected for the full possible pump head on the loop. Control valves shall be in accordance with the HVAC controls design guideline.
- All coils shall have non-ferrous headers and tubing.

2.03 Building Pumps

- Building loops shall be variable volume loops. Provide variable frequency drives for building pumps of 10 hp or greater. Pumps less than 10 hp may use control valves selected for the full pump head.
- The building chilled water pump and head should be selected with a reasonable safety factor for strainer plugging and future pipe roughness and flow. Pumps should be selected in the mid-points of their curves. Providing extra flow capacity is acceptable.

2.04 Direct Buried Piping System

- General: All underground piping for chilled water system distribution shall have a minimum diameter of 4" and shall be cement lined ductile iron.
- Pipe Joint Restraint Calculations: Submit complete calculations for underground chilled water pipe joints indicating the requirements for restrained and push-on joints. Submission of output data from an approved vendor computer selection/calculation program will be required to justify the use of push-on joints in certain locations. This program shall utilize the depth of cover indicated on the profile drawings.
- Ductile Iron Pipe: Pipe shall conform to AWWA C151 minimum class 50. All ductile iron pipe shall be cement mortar lined in accordance with AWWA C104 and shall have asphaltic coating. Piping 4" – 12" shall have 350 psig minimum working pressure. Piping 14" – 24" shall have a 300 psig minimum working pressure.
- Select backfill material shall be provided for bedding and backfill 12" above pipe.
- System drains and vents – Provide system drains at low points and system vents at high points according to details as attached.
- Fittings: Fittings for ductile iron pipe shall be ductile iron and rated a minimum of 250 psi working pressure. Fittings shall be cement mortar lined equivalent to the pipe lining.
- Mechanical Joint Fittings: Comply with AWWA C110. Where restained joints are identified, use Megalug Series 1100 system or approved equal. Gasket material shall be SBR
- Push-on Joint: Comply with AWWA C111
- Butterfly Valves: Comply with AWWA C504. Valve shaft to be type 304 stainless steel. Cast valves from gray or ductile iron. Provide interior coating of body and disk. Valves shall be furnished with buried service gearbox operator, shaft extensions, ground level position indicators and valve boxes.
- Gate Valves: Comply with AWWA C509. Stem shall be non-rising and shall be cast bronze. Valve body and wedge shall be ductile iron and shall be coated inside and outside with epoxy. The coating shall meet or exceed AWWA C550. Valves shall have a minimum pressure rating of 250 psi. Gate valves shall be US pipe or approved equal.
- Valve Boxes: Valve boxes shall be 2 piece cast iron with heavy duty traffic weight lid marked with valve number as shown on drawings (such as CWS –22). Valve boxes not in paving shall be supplied with a pre-cast concrete mowing ring.

2.05 System Pressure and Leak Test

- Length of test, unless otherwise approved, shall be a minimum of 4 hours. Contractor shall have conducted a preliminary pressure test prior to final acceptance test to locate and correct any pipe leaks.
- Chilled water piping shall be leakage rate tested. Leakage rate test shall be conducted at the same time as the hydrostatic pressure test. Leakage rate is defined as the quantity of water that must be supplied into respective underground piping system to maintain pressure within 5 psig of the specified hydrostatic test pressure after system has been vented and filled. Contractor shall document test results and sign/date each test.
- The maximum allowable leakage is determined by the following formula:

$$L = N*D*(P)^{1/2} / 7{,}400$$

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)

If measure leakage rate exceeds maximum leakage rate, repair with new materials and repeat test until satisfactory results have been obtained.

2.06 Control Logic

- Secondary chilled water pump logic should include:
  1. Pump speed is varied to maintain differential pressure
  2. Use VSD status for pump status instead of pump differential pressure switches.
  3. Backup pumps should start based on low differential pressure or VSD faults.

- Tertiary or building chilled water pump logic should include:
  1. Return water temperature control valve is modulated to maintain 54 ° F (adjustable) return water from the building to the chilled water distribution return. Not all buildings, such as 100% OA, will require return water control.
  2. When the building pump is commanded off, the return water valve shall close.

2.07 Building Service Entry

- Each building should include as a minimum, cutoff valves, temperature and pressure gauges, system drains and metering in accordance with metering guideline.

2.08 Accessible Distribution System Piping

- Piping in accessible tunnels and mechanical spaces shall be schedule 40, black steel pipe.