230510 CHILLED WATER SYSTEM

PART 1: GENERAL

1.01 RELATED CORNELL DESIGN AND CONSTRUCTION STANDARDS

A. Section 230000 – Basic HVAC Requirements
B. Section 230500 – HVAC Basic Materials and Methods
C. Section 230523 – Valves
D. Section 232500 – HVAC Water Treatment
E. Section 238216 – Coils
F. Section 230900 – Building Automation and Control System Guidelines

1.02 RELATED STANDARD DETAILS

A. Detail 3.1.1, Chilled Water System Pressure Sustaining Valve Detail
B. Detail 3.1.2, Building Chilled Water Piping Schematic
C. Detail 3.1.4, Process Cooling Schematic
D. Detail 3.1.7, Electromagnetic Chilled Water Meter Installation Detail
E. Detail 3.1.8, Ultrasonic Chilled Water Meter Installation Detail
F. Detail 3.4.3, Differential Pressure Transmitter Detail

1.03 CHILLED WATER SOURCE

A. The Campus Chilled Water System is a district cooling system comprised of the following, all pumping into a common piping system:

1. Two (2) central plants with two chillers and a total of 6,000 tons capacity located at Chilled Water Plant 3
2. Seven (7) plate and frame heat exchangers located at the Lake Source Cooling (LSC) Chilled Water Plant 4 facility with 18,000 tons capacity
3. One (1) 4.4 million gallon chilled water thermal storage tank

B. The chilled water plant and thermal storage tank provide peaking capacity and back up for LSC.
C. System temperature differential is critical to the operation of LSC, which is a large non-contact cooling system based on 39-41°F deep Cayuga Lake water (no mechanical refrigeration is used). A higher temperature differential increases the capacity of the facility. The system is operated year round with a campus supply temperature of 43-45 °F, and a supply/return pressure differential of 2 to 30 psid depending on the location in the system.

D. Each chiller has a constant volume loop with a dedicated constant speed pump that is separate from the distribution pumps.

E. The LSC facility heat exchangers are piped in a parallel arrangement, which in turn are in series with the distribution pumps. The number of heat exchangers on-line is dependent on the total chilled water flow through the plant. The LSC plant chilled water pumping is a variable volume, variable head loop out to the campus distribution system using variable speed pumps in parallel. The distribution pump speeds are varied to maintain constant differential pressure at various low differential points located in the piping system.

1.04 BUILDING CHILLED WATER CONNECTIONS

A. Building chilled water service connections to the campus distribution system is accomplished using a variable volume, primary-secondary interface with a temperature controlled two-way mixing valve. The recirculating loop control valve is modulated to maintain a mixed building supply water temperature of 47 °F when needed for summer air conditioning; and 48-52 °F when needed for winter air conditioning and process cooling loads.

B. The hydraulic separation (primary-secondary interface) at each building consists of a short section of full size pipe and a low pressure, drop, line size globe style, silent lift check valve with isolation valves. This section of pipe is referred to as the recirculating loop bypass line.

C. A portion of the campus distribution system is coated steel, and has cathodic protection to prevent external corrosion. For building systems that connect to the steel campus main distribution piping, a monolithic dielectric isolation fitting shall be provided on the building side of the main isolation valves. No hangers or connections (other than capped vent and drain valves) shall be installed between the isolating joints and the wall penetration. Monolithic dielectric isolation fittings are not required when connecting to HDPE campus distribution piping systems. The consultant is instructed to contact Cornell for project specific design parameters.

D. Building chilled water connections are to be accomplished as shown in Cornell Standard Detail 3.1.2, Building Chilled Water Piping Schematic.
PART 2: DESIGN GUIDELINES

2.01 GENERAL

A. The designer’s goal should be to design a system that can function as close as possible to variable flow constant temperature rise over the entire load range (all seasons). The designer should attempt to get as high a temperature rise as possible.

B. For facilities with chilled water loads at an elevation over 940 feet above sea level, a pressure sustaining valve shall be used as shown in Cornell Standard Detail 3.1.1, Pressure Sustaining Valve Detail. Acceptable models shall be as follows:

1. CLA-VAL Model 750-01
2. Watts Regulator Model F-116

C. Design pressure for all components shall be at least 150 psig at 100 °F.

D. Do not pipe any equipment drains directly to drain. Provide isolation valve, brass hose adapter, cap, and chain on all vents and drains.

E. In general, do not connect refrigeration condenser heat rejection systems to the campus chilled water system. It is preferable to use air cooled condensers and mechanical room ventilation. The use of campus chilled water for this application should be a last resort, requiring a process chilled water loop separated from the campus chilled water system with a plate and frame heat exchanger.

F. Major building renovations should include replacement of the building isolation valves with epoxy coated high performance butterfly valves.

2.02 PUMPING

A. The building chilled water pump head shall be selected with a reasonable safety factor for strainer plugging and future pipe roughness and flow. Providing extra capacity (flow) is acceptable. The building pump head is only necessary for piping, accessories, coils and process heat exchangers within the building loop.

B. Loads with similar pressure drops should be grouped together on a single building loop. More than one building loop can be designed into each building.

C. Process (continuous) loads and air conditioning loads (seasonal) shall be separated into separate loops. Design process loops with as high a supply temperature and temperature rise as possible.
D. If the process chilled water loop services equipment other than fan coil units in the lab spaces, the process loop or the loads must be separated from the campus system via a plate and frame heat exchanger. Do not provide user connection points to campus chilled water.

E. Large air handlers can be designed with “pumped coils.” This entails bringing the distribution piping to each air handler and setting up a dedicated constant volume secondary loop for each air handler coil and controlling the mixing valve on leaving air temperature.

F. Building chilled water pumps will be variable speed to enable pump capacity control with minimum energy usage. Pump speed should be controlled by one or more differential pressure transducers located at remote points in the building piping. Show the transmitter location(s) on the plans and schematic riser diagram.

G. “Booster” pumps in series shall not be used unless they are variable speed.

H. Provide two 100% pumps instead of multiple smaller pumps.

I. All pump schedules included on the contract drawings shall, as a minimum, include the following:

1. Pump head (FT)
2. Pump efficiency (%)
3. Motor efficiency (%)
4. Drive efficiency (%)
5. Pump capacity (GPM)
6. Pump spare capacity (GPM)
7. Pump speed (RPM)
8. Motor size (HP)

J. Provide a complete riser diagram/flow schematic on the contract drawings, which shall, as a minimum, include the following information:

1. All line sizes
2. All loads with flows
3. Riser flows
4. Control valves
5. Pumps with design flows and head
6. Differential pressure transmitter locations
7. Future pump and piping capabilities

2.03 CONTROL VALVES


2.04 METERING

A. Temperature and flow metering points are to be designed as shown on Cornell Standard Detail 3.1.2, Building Chilled Water Piping Schematic.

B. Chilled water BTU metering includes a flow meter, two temperature sensors, and a BTU processor, which is connected to the University EMCS. Basis of design shall use an electromagnetic meter. Contact Cornell for special conditions requiring the use of an ultrasonic meter. Acceptable manufacturers and models shall be as follows:

1. Basis of Design: Siemens Sitrans MAG 3100 (electromagnetic).

C. Temperature sensors associated with the chilled water meter shall be Resistance Temperature Device (RTD) as manufactured by JMS Southeast, Inc. Model 3X(X=3TF3)SBK6BZZ312ZWZ2AX(X=Fully Potted). Probe shall have date of manufacture stamped on the surface. Thermowells shall be JMS model 51AT2CUK ½ inch step shank, 316 stainless steel, 0.260 bore sized to insert a minimum of 1/3 pipe diameter into flow stream. The junction box shall be a 2 x 4 handy box connected to the thermowell with CPVC nipples from the well to the head. Terminal connections shall be to a termination strip on the back of the handy box so probe can be removed through the front with the handy box cover removed. Provide a spare test well (identical to the sensing well) with brass cap and chain at all sensor locations.

D. The flow meter and temperature sensors shall be coupled to a BTU meter flow processor “FP93” as manufactured by EMCO. The flow processor shall be connected to the University EMCS via Ethernet.

E. Install meter as shown on Cornell Standard Detail 3.1.7 – Electromagnetic Chilled Water Meter Installation Detail or Cornell Standard Detail 3.1.8 – Ultrasonic Chilled Water Meter Installation Detail.

F. If more than one building loop, or sub meters are required in a single building, multiple FP93 meters shall be connected to the University EMCS via Ethernet. Contact Cornell for metering needs beyond one total building meter.

G. Do not disconnect existing chilled water metering until new metering or communications are in place.