Introduction

This guide will discuss the scope of work, and technical requirements of connecting to the Energy Transfer Station(s) (herein referred to as ETS).

The Purpose of the ETS is to deliver chilled water for the customer load to which it is serving. Emicool, will deliver chilled water at the design temperatures specified under “Technical Requirements – General Conditions” to the connected buildings, subject to the scope of work and the district cooling technical requirements outlined in this document. The piping connection will be discussed in this document and is as shown on the attached typical schematics/drawings.

The scope or limit of work of Emicool and that of the Client is defined as per the attached Schematics. Emicool clients are kindly advised to adhere to the following design requirements to ensure successful implementation of District Cooling.
Scope of Works

Emicool Scope of Work

Emicool will design, supply, install, operate and maintain:

1. All distribution piping from the plant room to the valve chamber to be located one (1) meter inside the perimeter of the plot.

2. Heat exchangers or equivalent required for handing the connected load.

3. All required connection piping, valves, and controls from the first flange (from underground DCHW S/R pipe) inside the ETS (Energy Transfer Station) up to the point of the demarcation line as clearly indicated on the attached schematic diagram.

4. All industrial controls and automation required for the district cooling operation, including programmable logical controller (PLC), instrumentation and wiring as per this guide and attached schematic.

Client Scope of Work

Client or their representative shall design, install, operate and maintain the following in accordance with the technical requirements summarized elsewhere in this document.

1. All underground pipe (supply & return) from valve chamber of Emicool provided inside the plot to ETS, one (1) meter above the floor level.

2. All pipe conduit 32mm Ø x 2 no. parallel to the above (item 1) underground pipe.

3. All equipment, material, and works related to the internal chilled water piping and the air-side for each building.

4. 415 V, 50 Hz, 3-phase electric power supply to the ETS. Power requirements will be determined according to the client required demand and pipe pressure drop on building’s side as performed by Client’s designer.

5. Motor control center (MCC) in the electric room that incorporates:
   a. Main Circuit Breaker.
   b. Variable Frequency drives for the chilled water pumps.
   c. Capacitor banks for power correction.
   d. Distribution Board (DB) for ETS room lighting and receptacles.
6. Three variable speed pumps for internal distribution.

7. Pressurization pump set.

8. All piping, insulation and valves on the Client side of the ETS, after the demarcation line as indicated on the attached schematic.

9. Differential pressure transmitter across the far end supply and return chilled water pipes.

10. Control wiring of the differential pressure transmittal to the ETS.

11. Temperature transmitters on the chilled water mains as per attached schematic.

12. Chilled water treatment system including manual feed chemicals dozing pot with the necessary rust inhibitors and biocides quantity necessary for testing, commissioning and operation. A specialized professional company shall handle the water treatment system.

13. Fan coil unit(s) and chilled water pipe connection for the cooling of the ETS and electrical Switchgear (MCC).

14. Industrial grade automatic air vents (1”) at all the high points of the chilled water system.

15. Floor drain.

16. All ETS room civil and finishing works including opening and sleeve for the entering pipes.

17. The Distance between valve chamber and ETS Room should not exceed 25 meters running pipes.

18. ETS Room to have separate outside door and the key to hand over to Emicool.

19. Inside each ETS wire mesh barrier to be built to separate between Emicool scope of work and client scoped work.

**Technical Requirements**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling Capacity:</td>
<td>Based on Client demand load</td>
</tr>
<tr>
<td>Pipe Connection Size:</td>
<td>Based on Client demand load</td>
</tr>
<tr>
<td>Supply chilled water temperature, Emicool Side:</td>
<td>40°F (4.44°C)</td>
</tr>
<tr>
<td>Return chilled water temperature, Emicool Side:</td>
<td>56°F (13.33°C)</td>
</tr>
<tr>
<td>Supply chilled water temperature, Client Side:</td>
<td>42°F (5.56°C)</td>
</tr>
<tr>
<td>Return chilled water temperature, Client Side:</td>
<td>58°F (14.44°C)</td>
</tr>
<tr>
<td>Chilled water flow:</td>
<td>Based on Client demand load</td>
</tr>
</tbody>
</table>
Maximum variation in supply Chilled water temperature: + / - 1.8OF (1.0°C)

Maximum allowable system pressure: 10 bar

Design water velocities / Pressure drops:
Pipe size 2” and smaller: Min = 1.5 ft/sec, Max 2 ft /sec
Pipe size 2 1/2” and larger: Min = 0.75 ft /100 ft, Max 2 ft /100ft

**Design Particulars: Achieving the above conditions**

1. All air side equipment and chilled water piping shall be designed for the stated chilled water temperatures in the table above. This means that the flow required for 1 ton of cooling load is 1.5 USGPM of chilled water having a differential temperature of 16°F (8.89°C).

2. The terminal units control valves shall be two way equal percentage control valves for all air handling units and fan coil units with authority 30 – 40 %. Air handling units above 2,000 CFM shall have modulating equal percentage type. Fan Coil units with capacity equal and smaller than 2,000 CFM can be on/off or modulating type.

3. The Air handling units and fan coil units at the end of the faraway circuits ONLY shall have three way control valves to avoid chilled water stagnation and allow for the minimum pump flow. The number of air handling units or fan coil units designed for using three way control valve shall correspond to a maximum chilled water flow of 5% of full design flow. The bypass on the three-way valve should have a double regulating valve for proper balancing and shutting off the bypass whenever the system requires it.

4. All air handling units, fan coil units and main branches shall have double regulating balancing valves with self sealing test points used for chilled water flow measurement as required during balancing and commissioning. During commissioning phase, a digital-measuring instrument furnished by the valve manufacturer shall be used to translate quickly and accurately the valve pressure drop into corresponding chilled water flow.

5. Variable speed secondary chilled water pumps shall be used for the internal distribution of the chilled water system. Three operating pumps each sized for 40 % of design flow shall be used in order to allow flow control to vary between 12% and 100%. Pumps motors, and pump seal cooling shall be designed for variable speed operation range of 15 to 50 Hz (300 to 1,500 rpm). The variable speed pumps’ drives shall be controlled via EmiCool’s open protocol control system. Varying the chilled water flow is the only way to maintain the required differential temperature year round. Maintaining the required differential temperature is a key factor for efficient district cooling central plant operation. Pumps shall be centrifugal end suction for pumps equal or smaller than 150 Hp and double suction horizontal split for pumps larger than 150 Hp, of adequate flow capacity and head to satisfy the system requirements.
6. The minimum mechanical efficiency of the pump shall be 80% and the electric efficiency of the pump motor 95%. The variable speed drive efficiency shall be 97% at 50 Hz (1,450 rpm), 95% at 35 Hz (1,000 rpm), 90% at 25 Hz (725 rpm) and 85% 15 Hz (300 rpm).

7. Install strainers on all AHU supply chilled water pipe.

8. Pressure test the network hydraulically at one and a half the design pressure at each of the new buildings/villas and distribution piping for a period of not less than 24 hours to ensure that the pipes are free from leak.

9. Perform a complete and thorough flushing of the internal chilled water piping network using cleaning chemicals as recommended by EmiCool and clean running water, so that at the time of connection to EmiCool’s ETS, the client’s piping system is full of clean water and is clear from all unwanted debris. To do that, Client has to install temporary bypasses as indicated on the attached schematics for the purpose of circulating water through the internal network prior to connection to the ETS. The heat exchangers shall be isolated during flushing. EmiCool needs to approve the flushing method used and the state of the water in the pipes before connecting to the network.

10. Install and wire differential pressure transmitter(s) across the far end of the chilled water pipes, as shown on the attached schematic to control variable chilled water flow based on system demand. Exact location shall be coordinated with EmiCool Engineer.

11. Pipe pressure drop calculations and pumps flow-head diagrams and differential pressure set point at circuit end for each of the connected buildings are to be coordinated with EmiCool during design stage.

12. Furnish and install VFD drives in the MCC with the following characteristics in order to be controlled and monitored by EmiCool Programmable Logical Controller PLC installed in the ETS room.

   a. Analog Input:
      i. 0-10 V DC, input impedance 200 kΩ
      ii. 4-20 Amps, input impedance 250 Ω
      iii. Differentially isolated external potentiometer, 0-10 V DC, 1 kΩ minimum.
   b. Digital Input: 6-programmable positive or negative control logic
   c. Auxiliary Supply: 24 V DC ± 20%, 100 mA
   d. Reference Supply: 10V DC (-0% to +3%), 10 mA
   e. Analog Output: Programmable: 0-20 mA, Impedance: 500 Ω, Resolution: 10-bit, ± 3%
f. Digital Output: 2 programmable from C Relays, 250 V AC 2 Amp, or 30V DC 2 Amp resistive. 1 programmable open collector, 48 V DC, 50mA

g. Differential Pressure Transmitter: Electronic, output: 4-20mA dc signal, linear with differential pressure, into 1000 ohms, isolated.

h. Temperature Transmitter Output: 4-20mAdc linear with temperature into 1000 ohms, isolated.

i. Test, adjust and balance the hydronic system to make sure that the chilled water requirement of each fan coil unit and air handling unit is met. Preferably the Testing, Adjusting and Balancing shall be carried out by a specialized third party commissioning firm.

13. Recommended manufacturers for pumps are ITT Bell & Gosset, Goulds, Aurora, KSB, Flowserve, Weir or approved equal. Country of origin shall be Western Europe of USA.

14. Recommended manufacturers for the VFDs are Allen Bradley, ABB, GE, or similar. 

15. Recommended manufacturers for the Differential Pressure transmitter are Rosemount, Yokogawa, E+H, Sen Sit, Dieterich, Barton or approved equal.