CHAPTER 6 HVAC SYSTEM CONTROL

6.1 INTRODUCTION

The capacity of the HVAC system is typically designed for the extreme conditions. Most operation is part load/off design as variables such as solar loads, occupancy, ambient temperatures, equipment & lighting loads etc keep on changing through out the day.

Deviation from design shall result in drastic swings or imbalance since design capacity is greater than the actual load in most operating scenarios. Without control system, the system will become unstable and HVAC would overheat or overcool spaces.

HVAC control systems are typically closed loops. A Closed-loop Control System, also known as a feedback control system is a control system which uses the concept of an open loop system as its forward path but has one or more feedback loops (hence its name) or paths between its output and its input.

Closed-loop systems are designed to automatically achieve and maintain the desired output condition by comparing it with the actual condition. It does this by generating an error signal which is the difference between the output and the reference input.

6.2 HVAC CONTROL SYSTEM

6.2.1 PAU and FCU control

6.2.1.1 Introduction

The Coil Unit Controllers are designed to control heating, ventilation and air conditioning (HVAC) systems. Conceptually the FCU consists of controller for cooling. Outputs are provided for controlling cooling liquid valves as well as relays for driving fan motors. An input is provided for a resistive type temperature sensor. Programmable inputs are provided for peripherals such as smoke detectors, motion detectors, window open/close sensors, drip tray overflows, dirty air filters and airflow detectors.

6.2.1.2 Piping Diversity

Diversity in piping is based on what type of valves are used. To maintain the correct space condition, three-way or two-way control valves are used.

When two-way modulating control valves) are used, the flow to the coil is restricted rather than bypassed. If all the valves in the system are two-way type, the flow will vary with the load. If the valves are properly selected, the temperature range remains constant and the flow varies directly with the load. In this case the diversity is applied to the chilled water flow rate.
6.2.1.3 Electric control diagram

6.2.2 Chilled water pump control

6.2.2.1 Introduction

Protecting the pump and the pump motor are priorities because a pump failure can have serious consequences. At a minimum make sure the motor and pump don’t overheat and the pump doesn’t run dry. Design the pump control panel based on the application and customer requirements.

A Pump Control Panel has to know the status of process variables required to control and protect the pump. This means it has to connect to devices that are monitoring the process.

Note:
1. The dashed line is wired by user at site.
2. VALVE1—cool water valve
- **Motor Overloads**: Pump Protection for when the pump motor current is above its Full Load Amp rating.
- **Temperature Sensors**: Pump Protection when the pump or motor are above their Temperature rating.
- **Level Sensors**: Pump control and protection to insure the pump doesn’t run dry
- **Flow Sensors**: Used to verify the pump is moving fluid
- **Pressure Sensors**: Used for pump control and to adjust speed

**6.2.2.2 Power and control circuit**

We using 3 pumps for chilled water supply (2 is for running and 1 is for back up), we use inverter to change the flow rate of water (the back up pump uses the inverter of those it replaces).

Using lecture of supervisor Nguyễn Hồng Phương, we get:

**PUMP SCHEMATIC CHART**
PUMP 2 CONTROL CIRCUIT

CONTROL CIRCUIT

PUMP 3 CONTROL CIRCUIT

CONTROL CIRCUIT
6.2.3 Chiller control

6.2.3.1 Introduction

The variable primary flow (VPF) design eliminates the constant flow chiller pumps and uses the variable flow pumps to circulate water throughout the entire chilled water loop.

VPF system operate to maintain a target differential pressure, ΔP, at a specific point in the system. This pressure difference tends to decrease when the air-handler control valves open in response to increasing loads. To restore the ΔP across the system, the pump controller increases the speed of the pump. Conversely, when the air handler control valves close in response to decreased coil loads, the pump controller slows the pump speed to maintain the target ΔP.

Meanwhile, the plant controller stages the chillers on and off to match cooling capacity with system load. If the air handlers operate properly, the difference between the return and supply water temperatures, ΔT, remains nearly constant. Therefore, increasing the water flow through the chiller evaporators increases the load on the operating chillers.
6.2.3.2 Electric control diagram

The following connection recommendations are intended to ensure safe and satisfactory operation of the unit:

These units are suitable for 380 V, 3 phase, 50 Hz nominal supplies only.

- **Chilled Liquid Pump Starter**: Terminals 23 and 24 close to start the liquid pump. The pump contact will not close to run the pump if the pump has run in the last 30 seconds, to prevent pump motor overheating.

- **Run Contacts**: Terminals 25 and 26 close to indicate system 1 is running
  Terminals 27 and 28 close to indicate system 2 is running.

- **Alarm Contacts**: Terminals 29 and 30 for No. 1 system
  Terminals 31 and 32 for No. 2 system.

- **System Inputs**: All wiring to the control terminal block (nominal 30 Vdc).
  - *Flow Switch* terminals 13 and 14
  - *Remote Start/Stop* terminals 13 and 51
  - *Remote Reset of Chilled Liquid Setpoint* terminals 13 and 20
  - *Remote Load Limiting* terminals 13 and 21 the PWM input to
6.3 BUILDING MANAGEMENT SYSTEM

A building management system (BMS) is a control system that can be used to monitor and manage the mechanical, electrical and electromechanical services in a facility. Such services can include power, heating, ventilation, air-conditioning, physical access control, pumping stations, elevators and lights.

By using BMS, trained customer can easily keep track with the system’s operation and intervene to the operation when necessary.

6.4 REFERENCE

(1) Chiller application guide
(2) Fundamental of HVAC controls
(3) “Electric control of HVAC system” Lecture of Nguyễn Hồng Phương
(4) Web Based Chiller Plant Optimal Control-A Case Study