Fundamentals of DDC

Air Handling Unit Section

Presented by:
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Block Objective

The objective of this block is to develop an understanding of the control strategies that may be used in the control of the major components typically found in the air handler. Subsystems that are included in this section include heating coils, cooling coils, humidifiers, and combined processes.

Processes

- Primary Heating Coils
  - Hot Water
  - Steam
    - One Valve
    - Two Valves
- PreHeat
  - Hot Water
  - Steam
    - One Valve
    - Two Valves
    - Face & Bypass

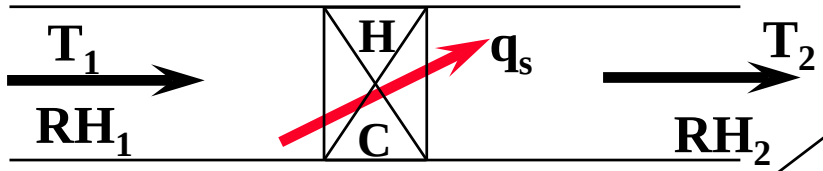
Processes

- Cooling Coils
  - Chilled Water
  - Chilled Water Face & Bypass
- Humidification
  - Steam
- Reheat
  - Reheat w/ Cooling Coil
  - Reheat w/ Cooling Coil & Humidifier

Heating Control Strategies

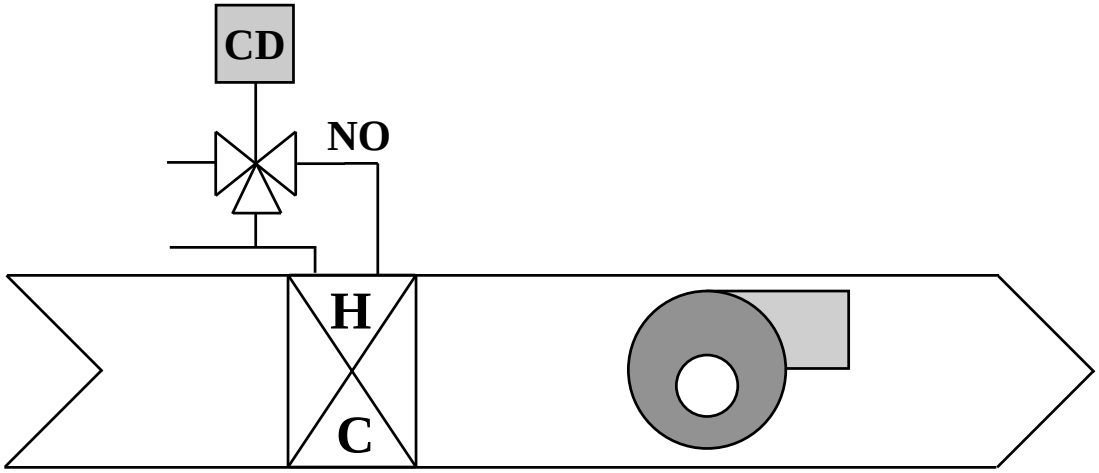
- Zone Control
- Discharge Control
- Outside Air Reset of Discharge Air
- Zone Reset of Discharge Air
- Discrimination Reset
- Outside Air and Zone Reset of Discharge Air

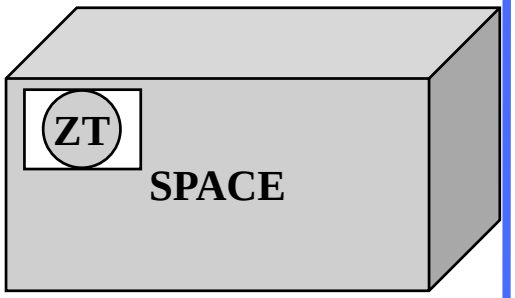
Psychrometrics of Heating



$$q_s = 1.1 \times CFM \times \Delta T$$

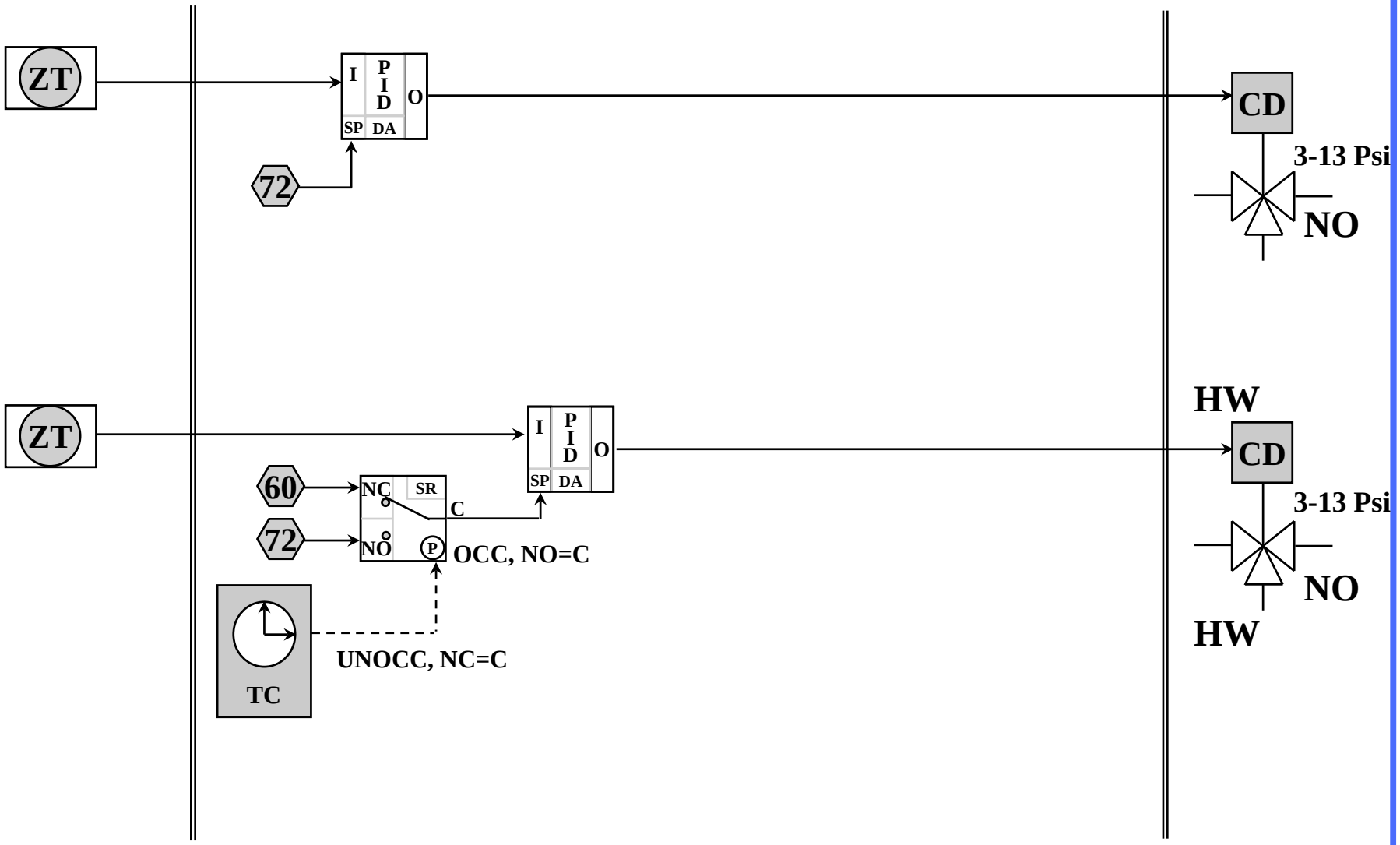
Zone Control of HW Heating Coil



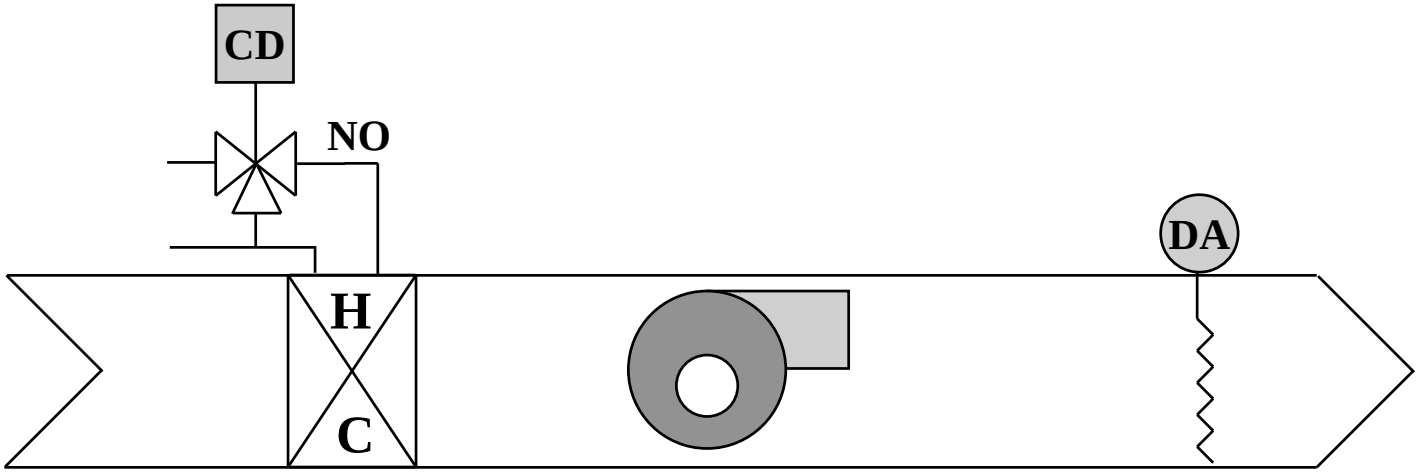


- **Simple closed loop control with a fixed setpoint, or reset based on occupancy**
- **Small throttling range of 2-4 F. will provide stable proportional control. PI and/or PID are not typically required unless the zone requires minimum offset for special equipment or processes.**

Control Logic Diagram

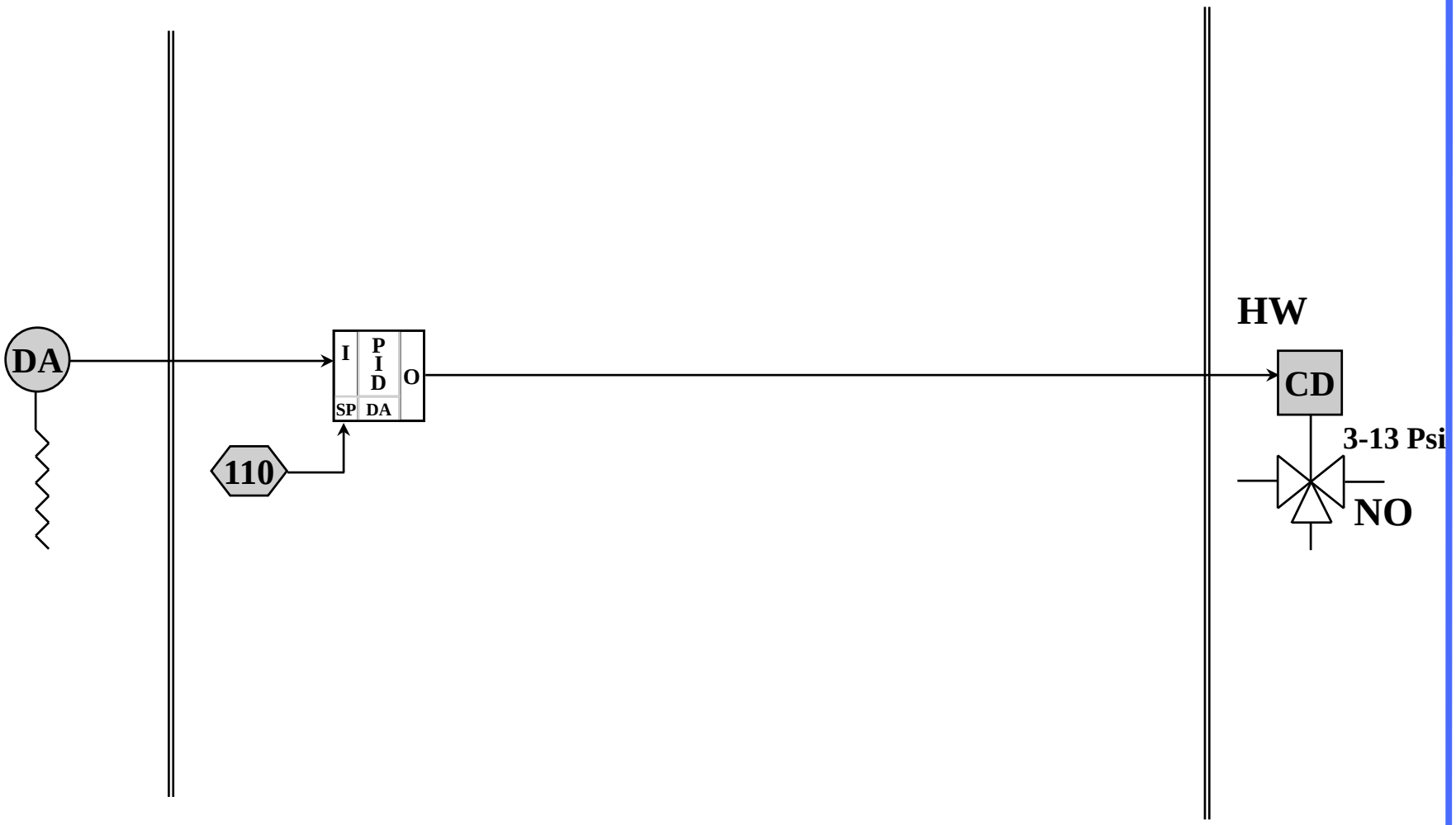


Discharge Control of HW Heating Coil

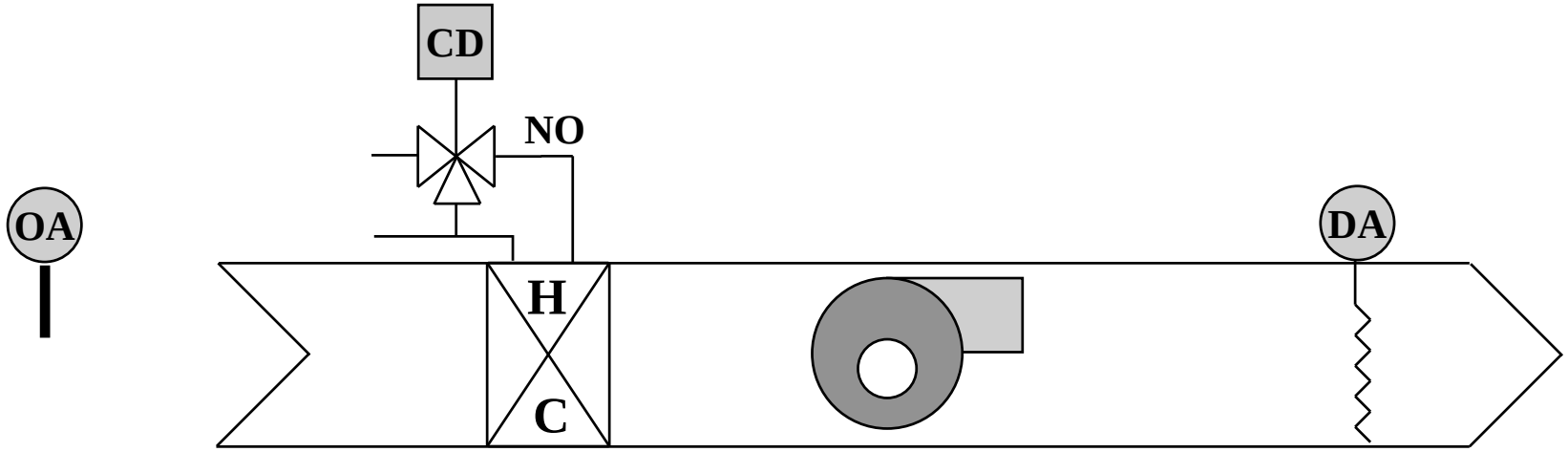


- Simple closed loop control with a fixed setpoint
- Larger throttling range of 8-10 F. usually required to provide stable proportional control. PI and/or PID may be applied if necessary to control offsets

Control Logic Diagram

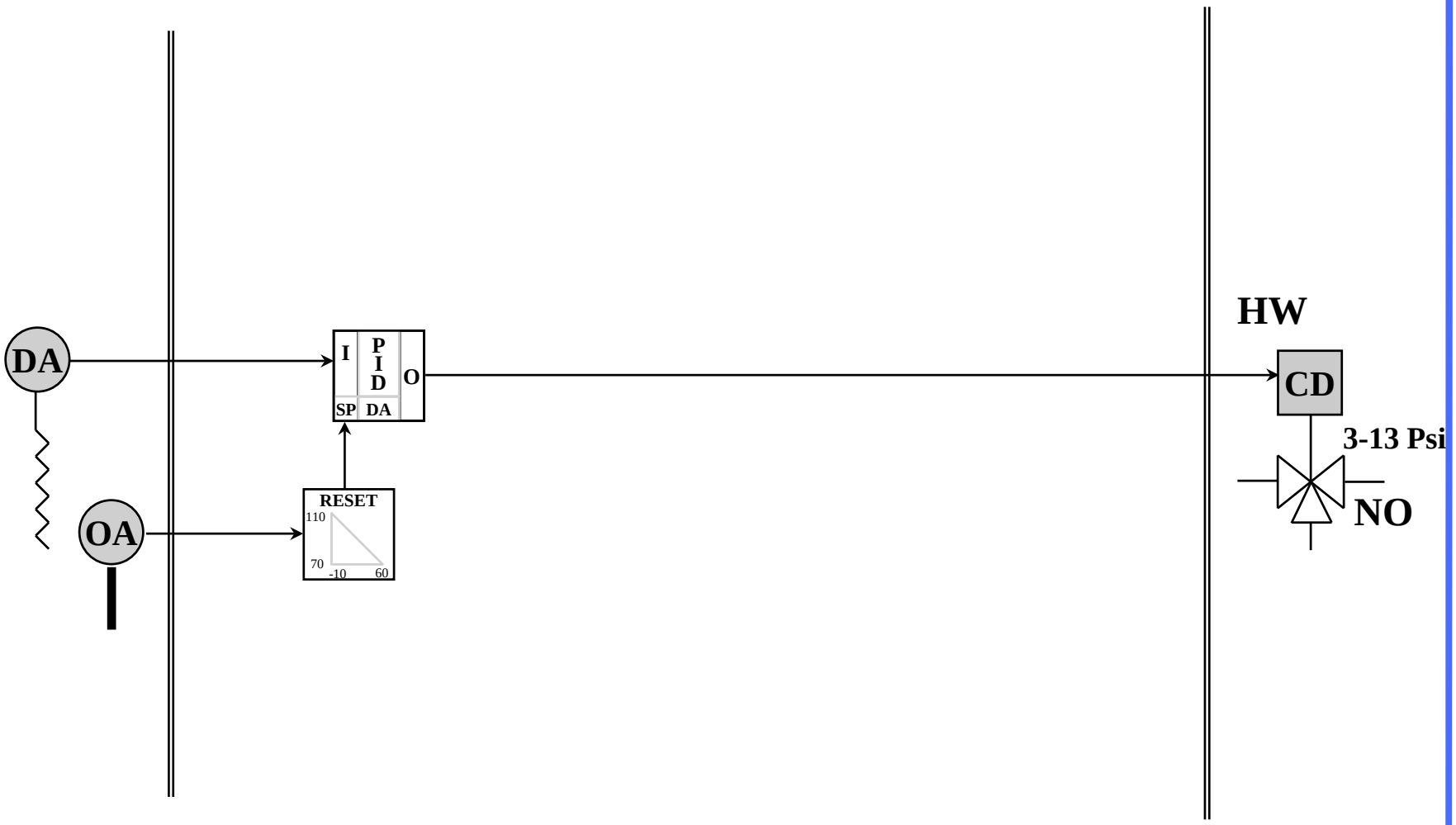


OA Reset of Discharge Air

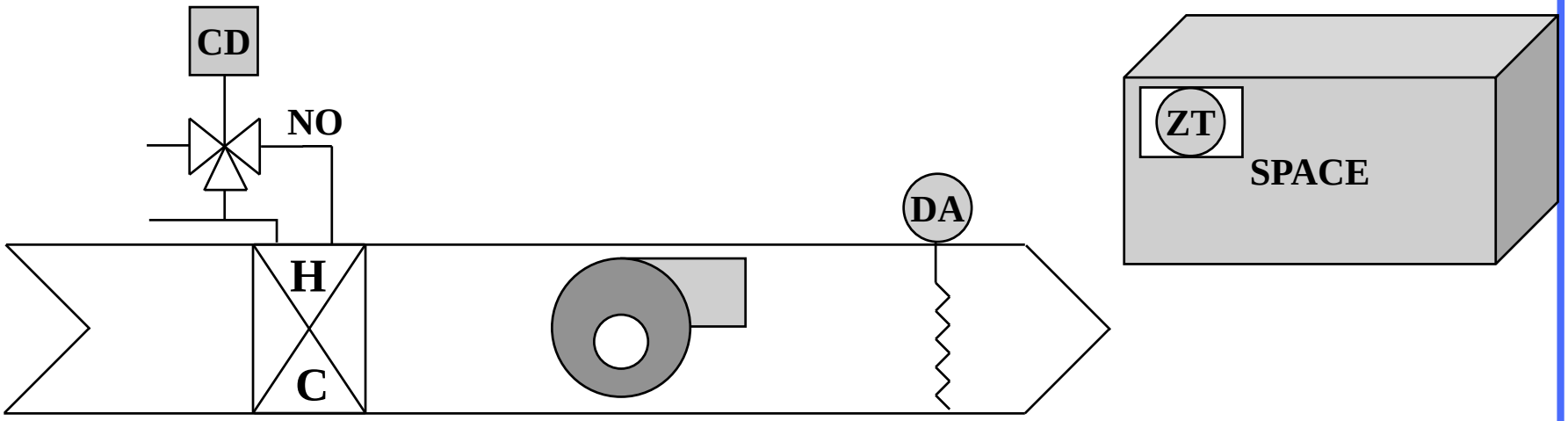


- Primary control loop is the discharge air
- The setpoint is reset as a function of the outside air temperature. This is a reverse reset application based on an open loop variable. The OA sensor does not "feel" the effect of the control action.
- OA should be a significant load of the zone

Control Logic Diagram

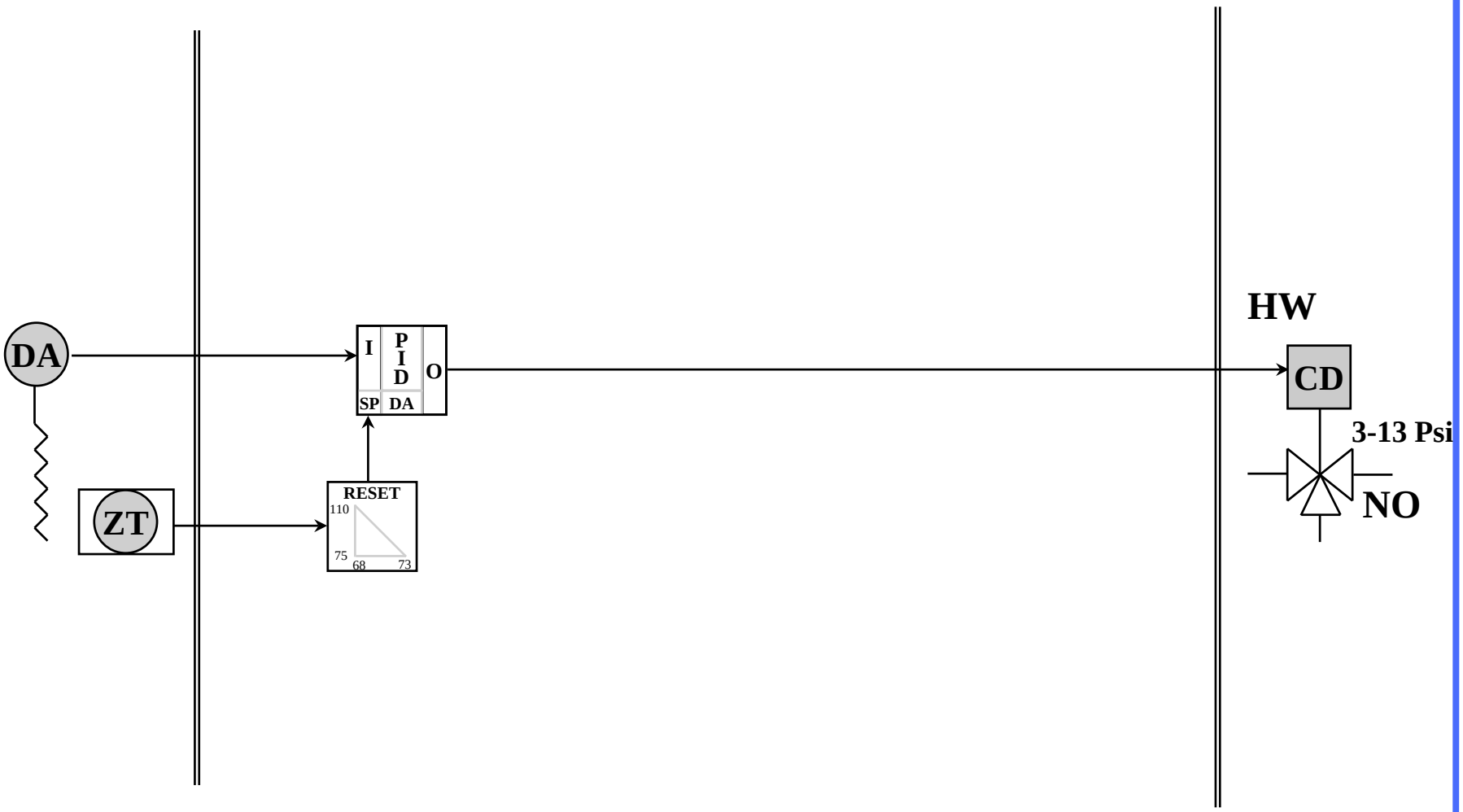


Zone Reset of Discharge Air

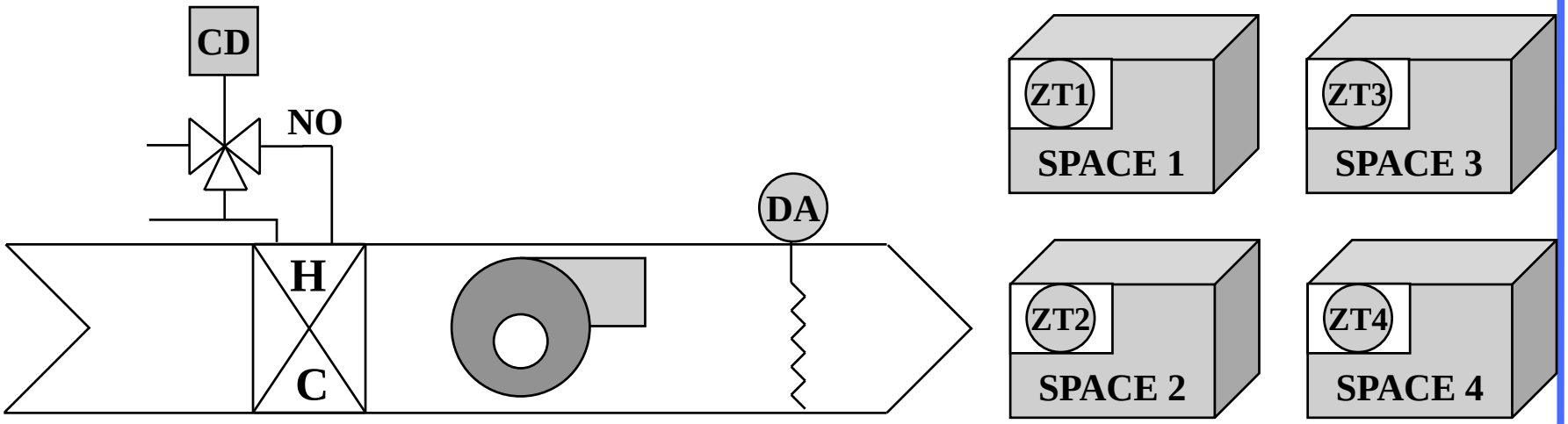


- Primary control loop is the discharge air
- The setpoint is reset as a function of the zone air temperature. This is a reverse reset application based on an closed loop variable. The Zone sensor does “feel” the effect of the control action.

Control Logic Diagram

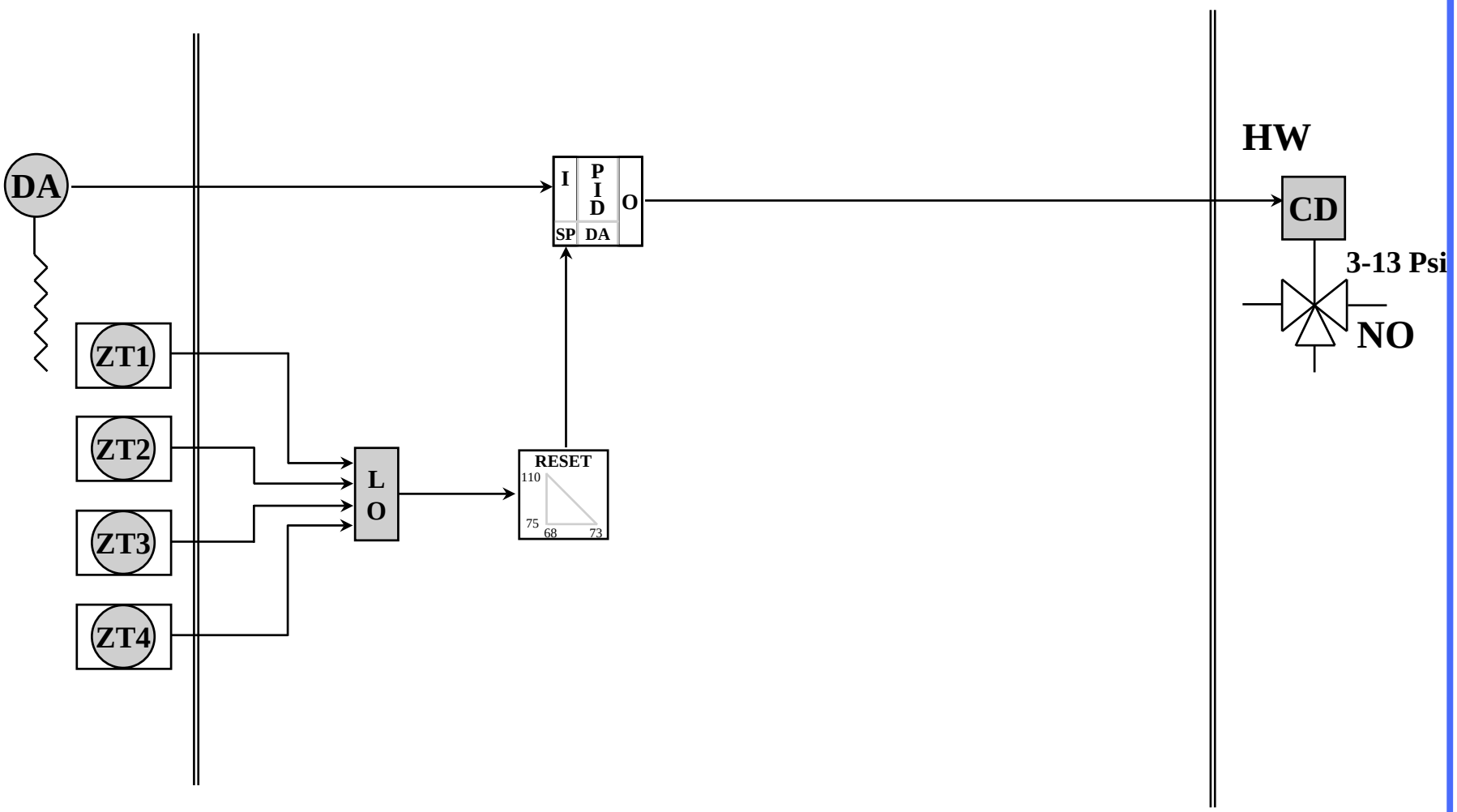


Discrimination Reset of Discharge Air

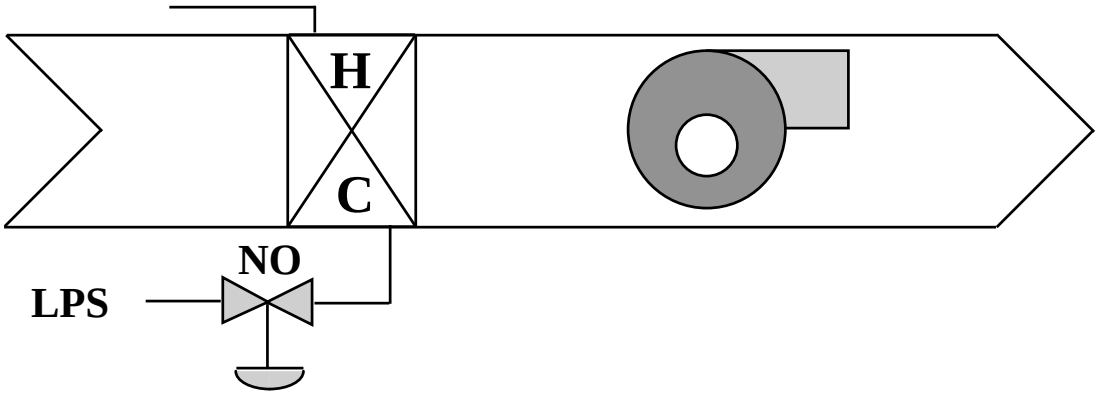


- Primary control loop is the discharge air
- The setpoint is reset as a function of the coldest zone air temperature. This application can be used with a small number of zones or a small number of representative zones.

Control Logic Diagram

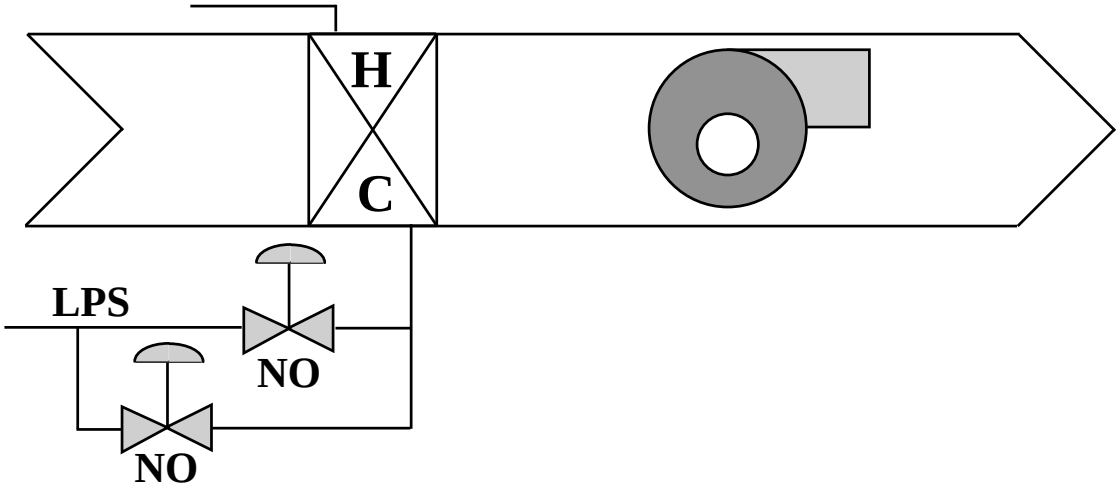


Steam Heating Coils (One valve)



- Coil performs similarly to HW Coil
- Same Control Strategy options as HW Coils
- May need larger throttling range for stable proportional control (8-12 F.). PI and/or PID may be applied due to potential larger offsets.

Steam Heating Coils (Two valves)

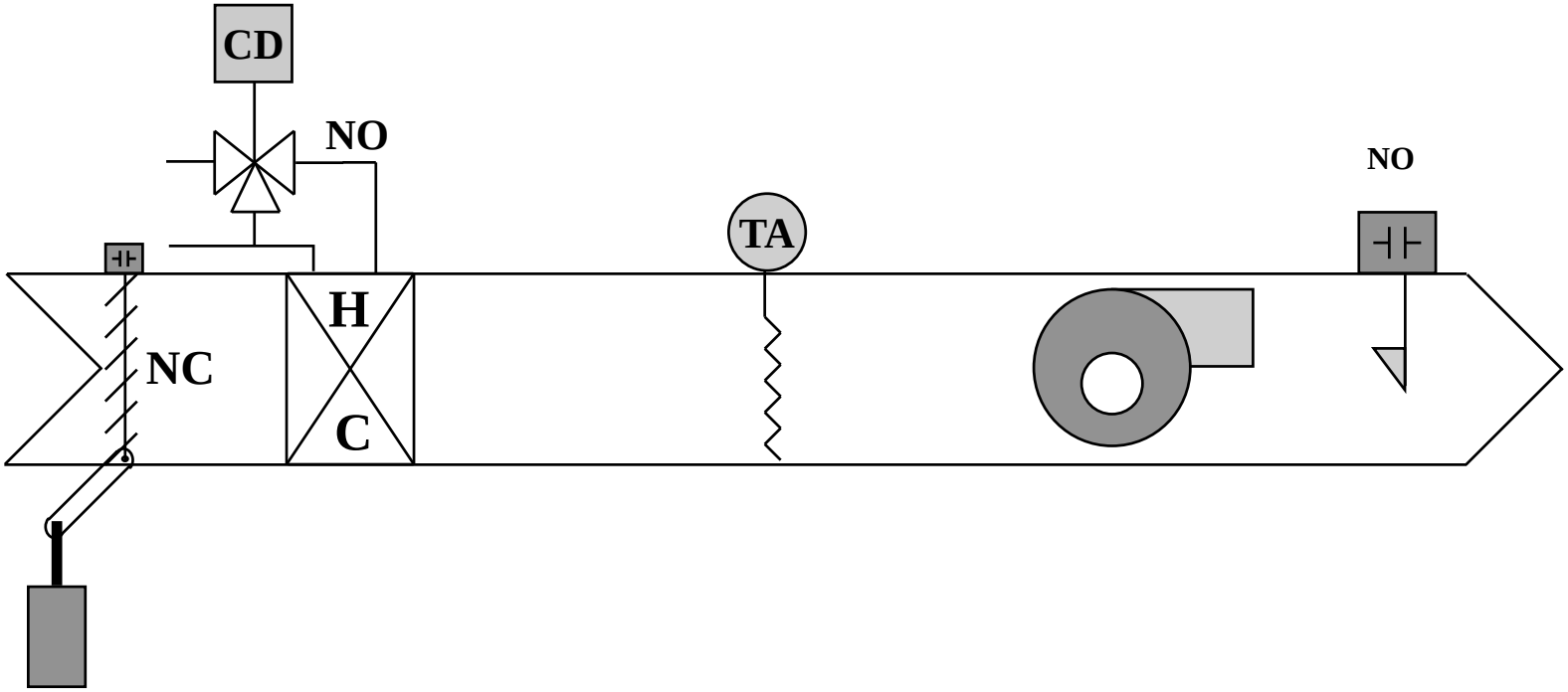


- Same Control Strategy options as HW Coils
- Different Controlled Device (1/3, 2/3 valves)
  - Larger Coils
  - Stability
  - Two valves in parallel

Preheat Options

- High requirements for minimum outside air coupled with low outside air temperatures can cause unacceptable mixed air temperatures.
- Preheat coils (steam, hot water, or electric) are used to maintain a minimum temperature or a specified temperature in the mixed air section.
- The strategy will depend on the minimum acceptable quantity of outside air and the capacity of the preheat coil
- 100% OA Systems
- IAQ resetting OA up requiring Preheat coils

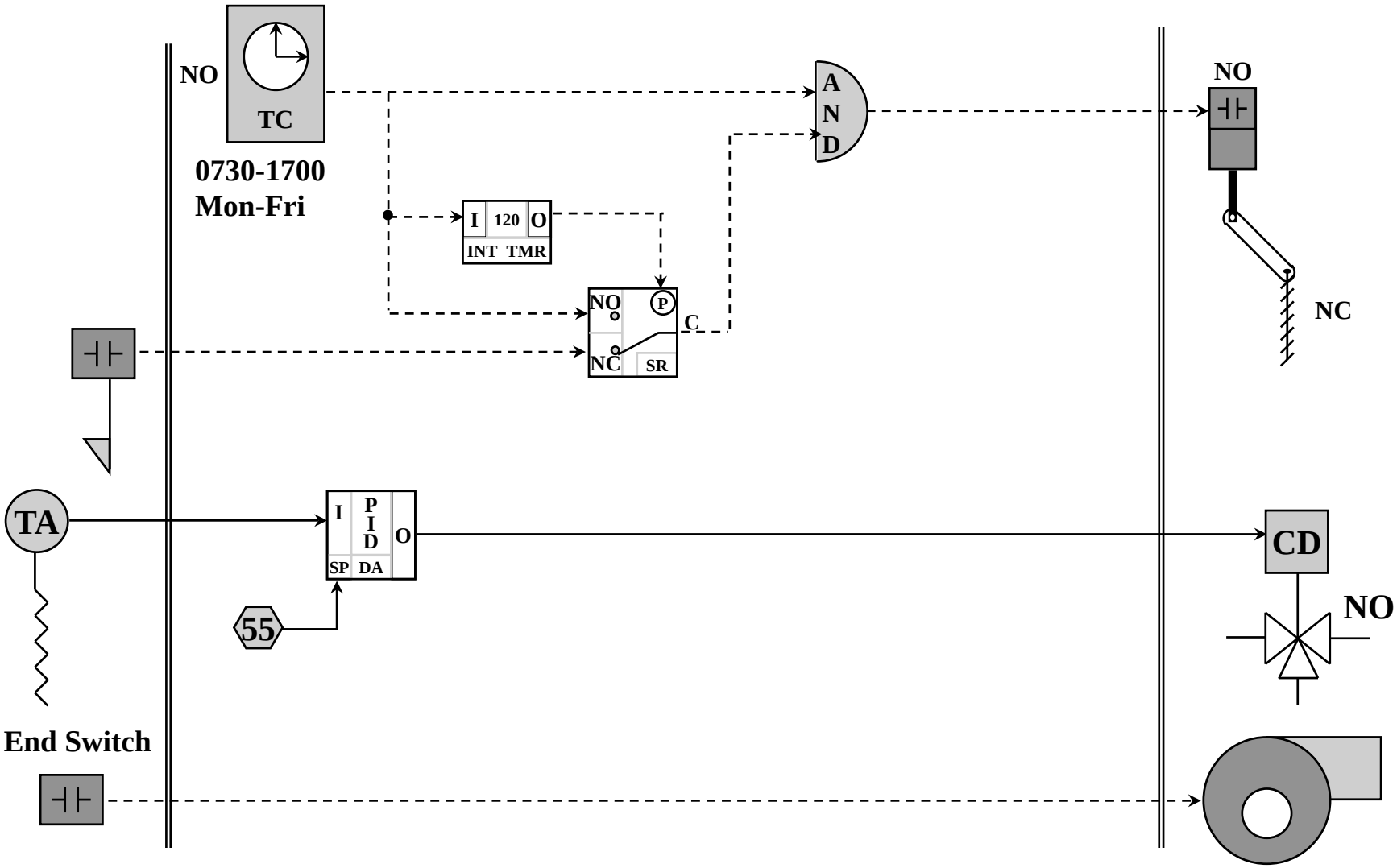
100% OA with Preheat Coil



The Logic

The outside air dampers shall open on a call for fan operation (time clock). The fan shall run once end switch is proved. The preheat coil control valve shall modulate to maintain a tempered air temperature of 55 F. +/- 3 F. The OA dampers will close on fan shut down.

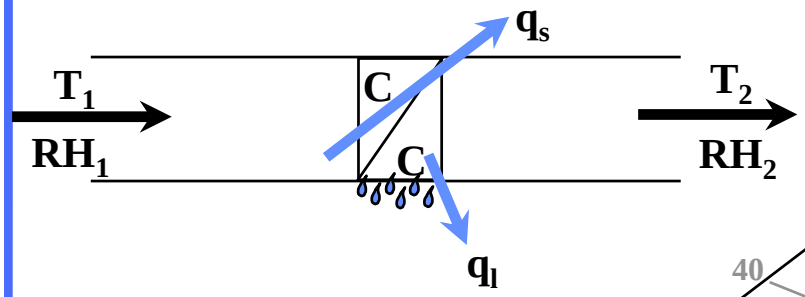
The Control Logic



Cooling Control Strategies

- Zone Control
- Discharge Control
- Outside Air Reset of Discharge Air
- Zone Reset of Discharge Air
- Discrimination Reset
- Direct Expansion Coils

Cooling & Dehumidification

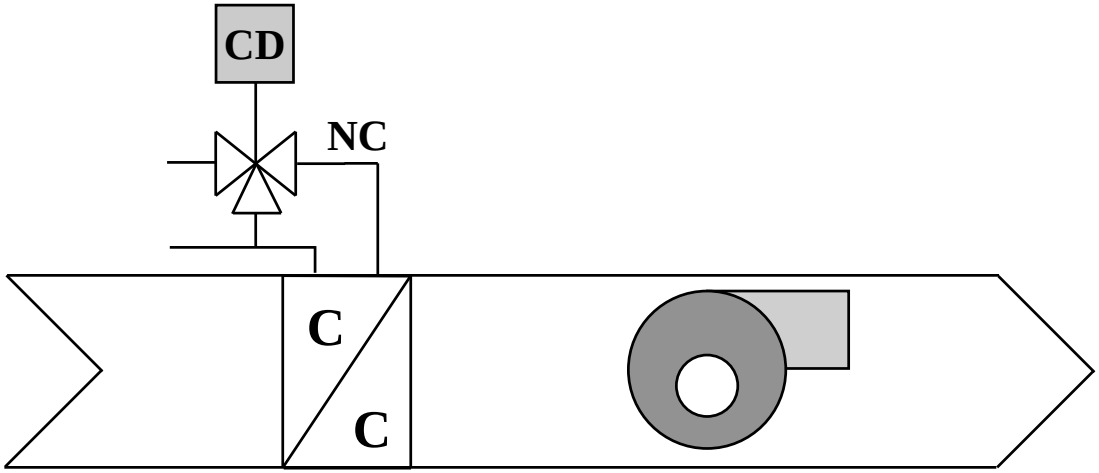


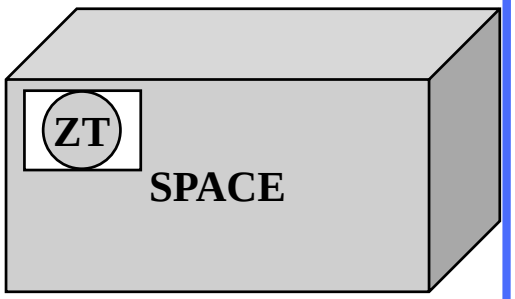
$$q_s = 1.1 \times CFM \times \Delta T$$

$$q_l = 4840 \times CFM \times \Delta W$$

$$q_t = 4.5 \times CFM \times \Delta h$$

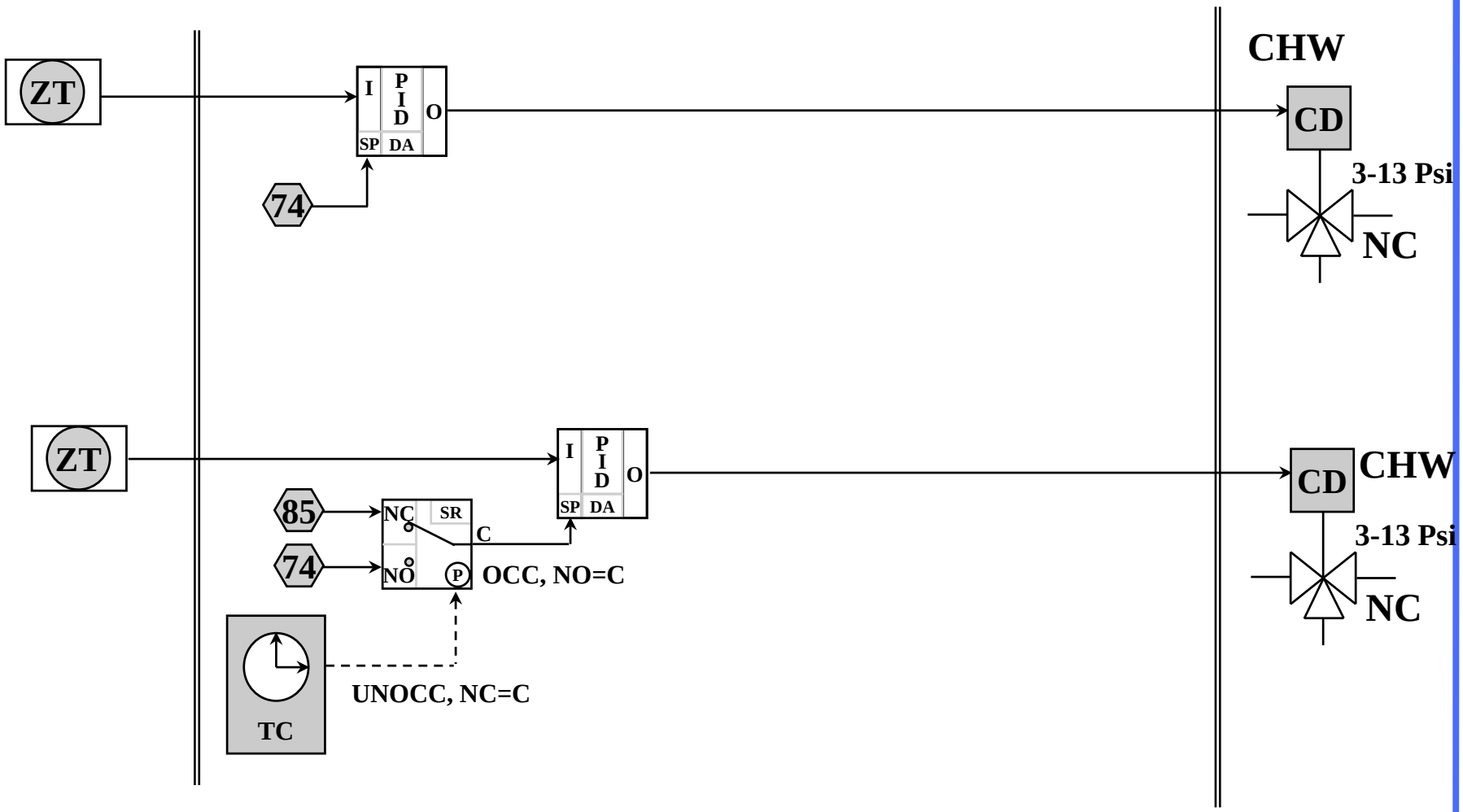
Zone Control of Cooling Coil



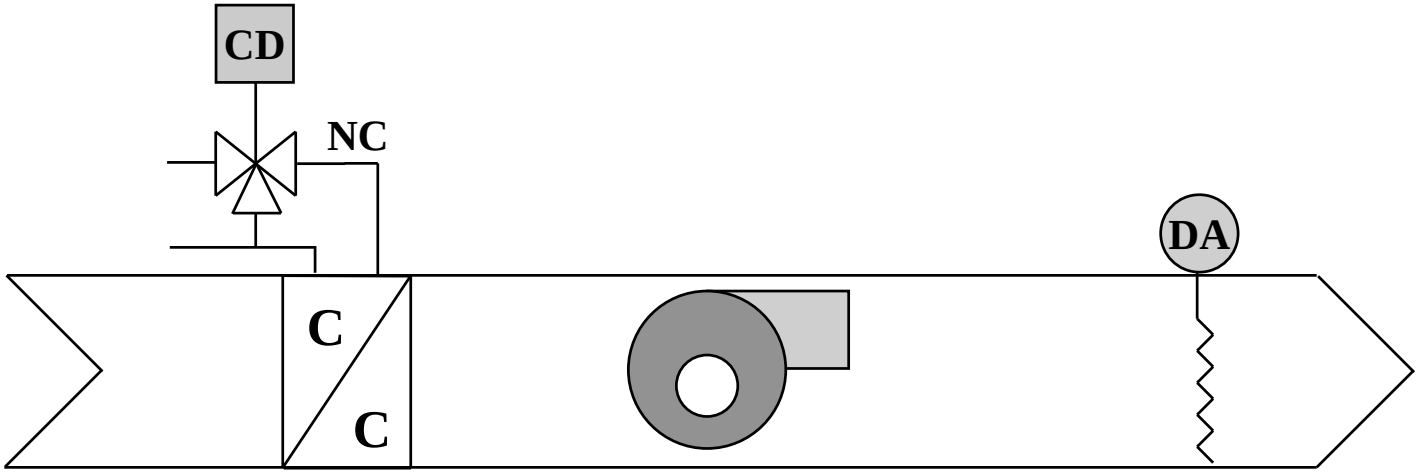


- **Simple closed loop control with a fixed setpoint, or reset based on occupancy**
- **Small throttling range of 2-4 F. will provide stable proportional control. PI and/or PID are not typically required unless the zone requires minimum offset for special equipment or processes.**

Control Logic Diagram



Discharge Control of Cooling Coil



- Simple closed loop control with a fixed setpoint
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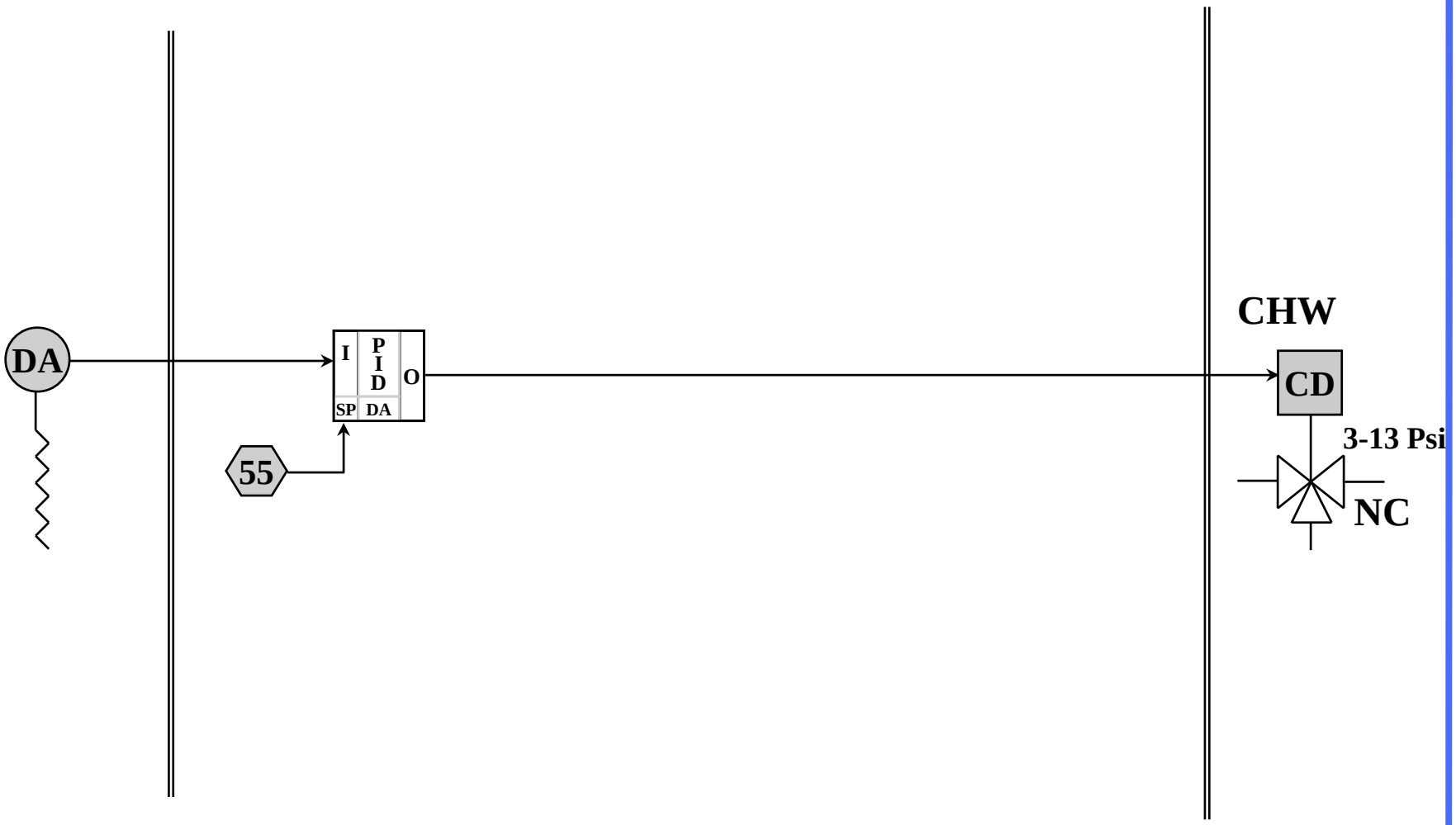
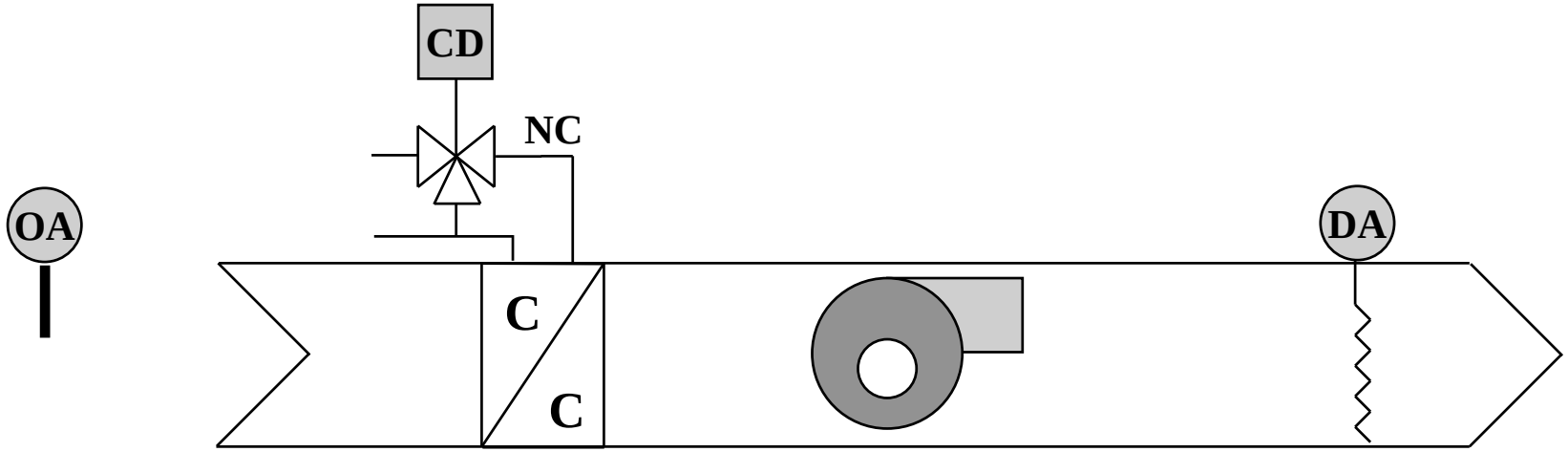
Control Logic Diagram

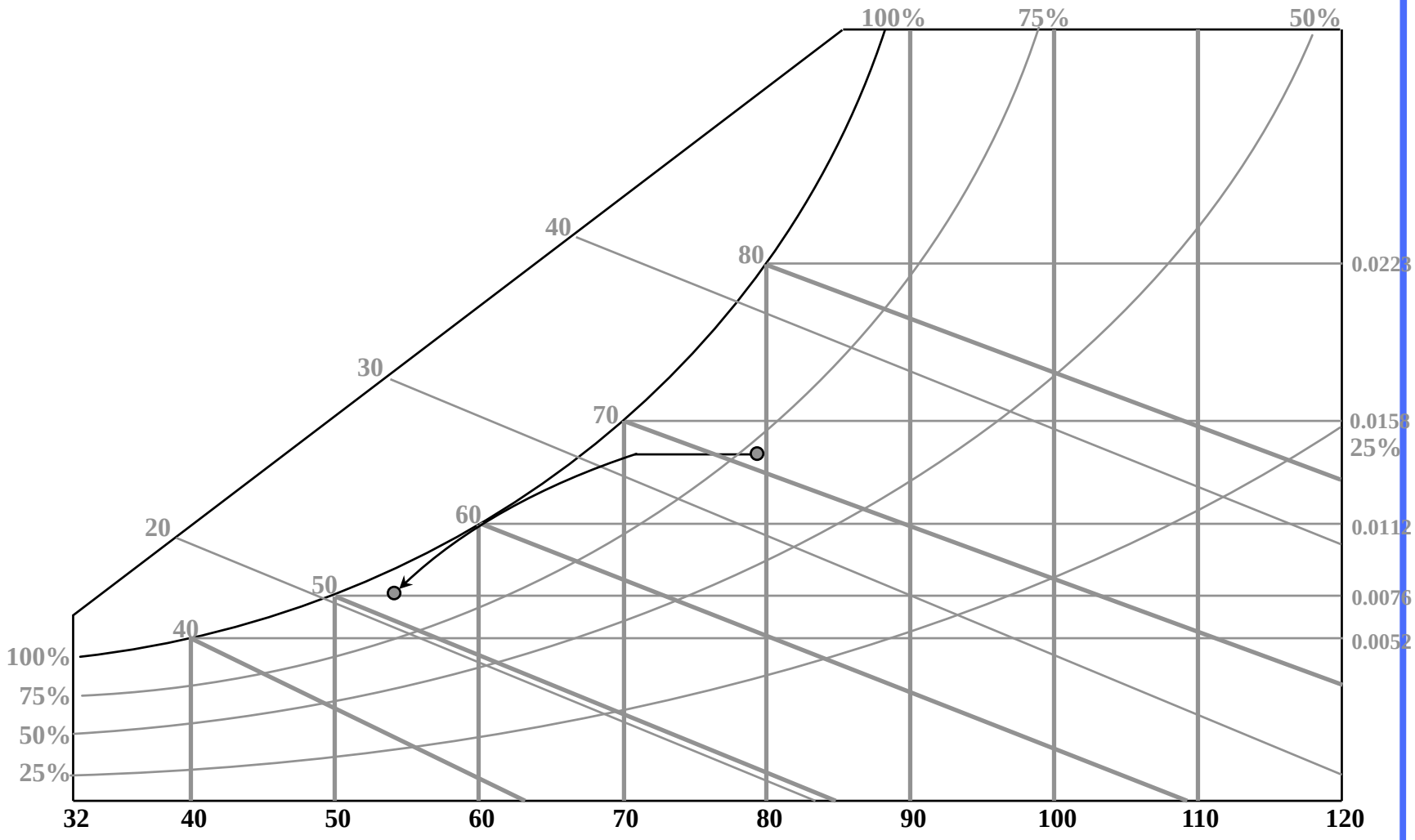


OA Reset of Discharge Air

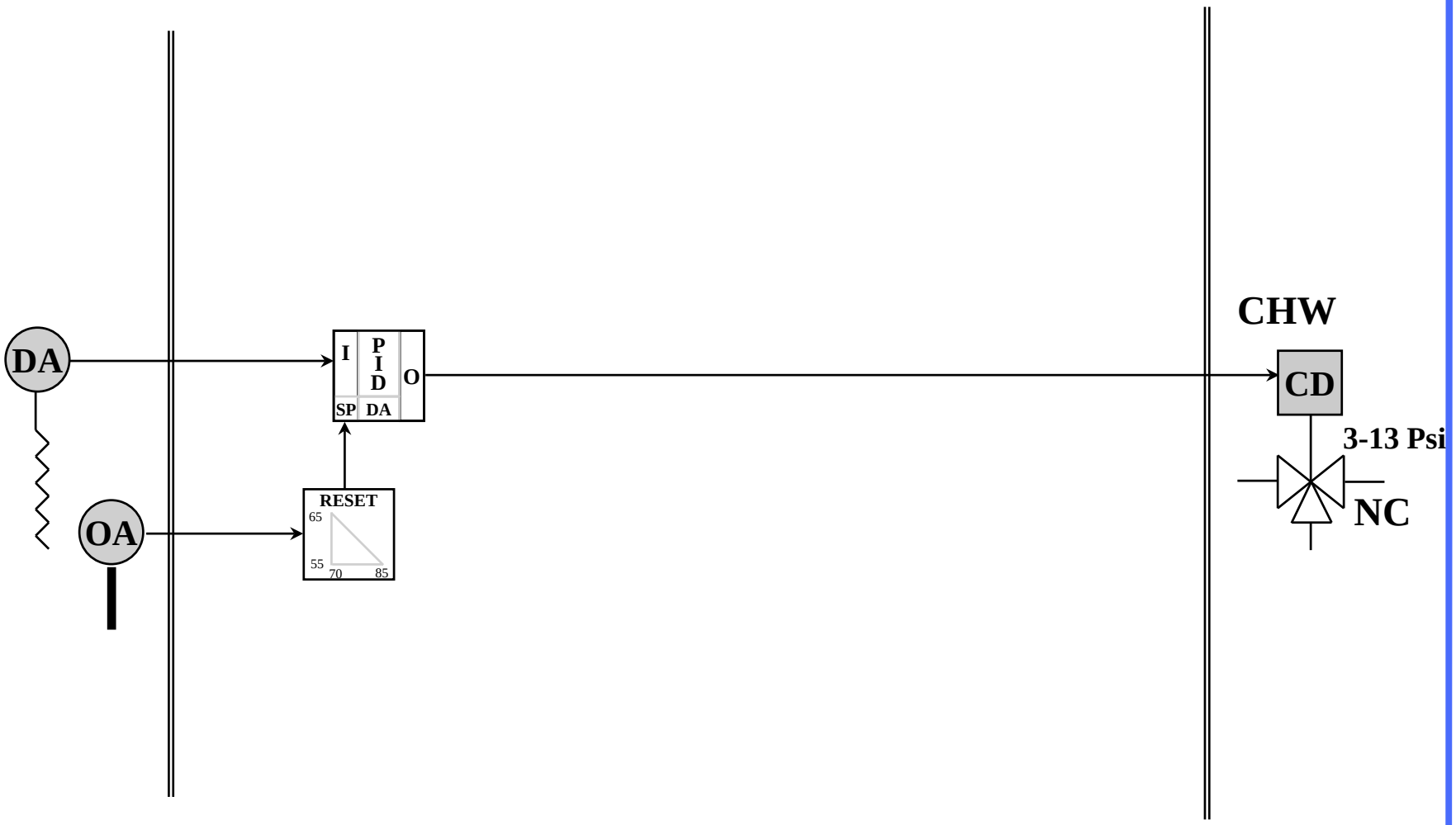


- Primary control loop is the discharge air
- The setpoint is reset as a function of the outside air temperature. This is a reverse reset application based on an open loop variable. The OA sensor does not "feel" the effect of the control action.
- OA should be significant load of the zone

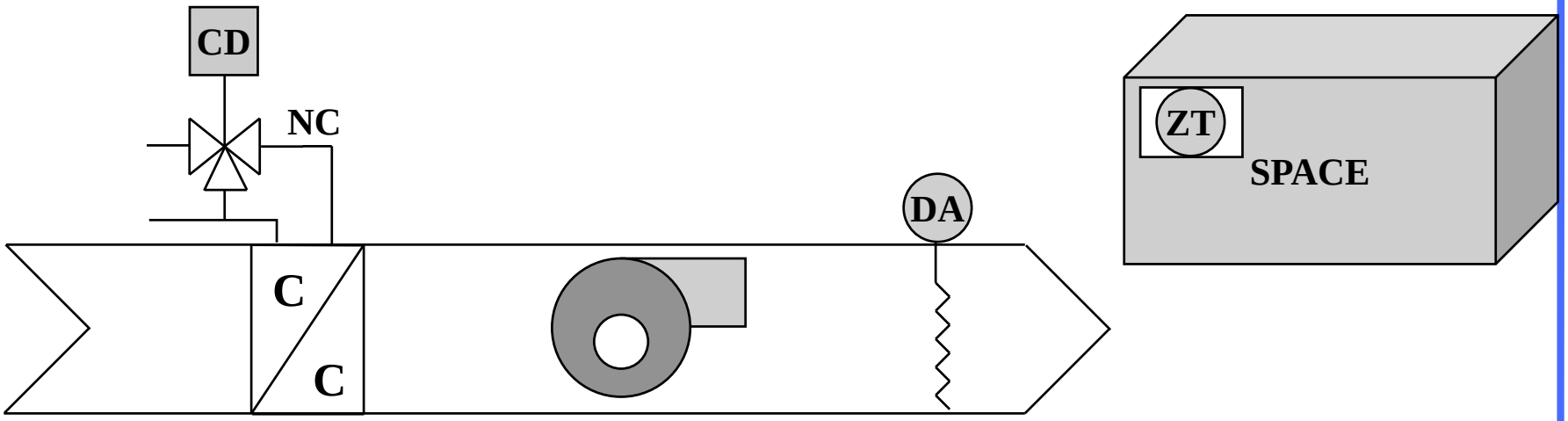
Cooling Coil Reset



Control Logic Diagram

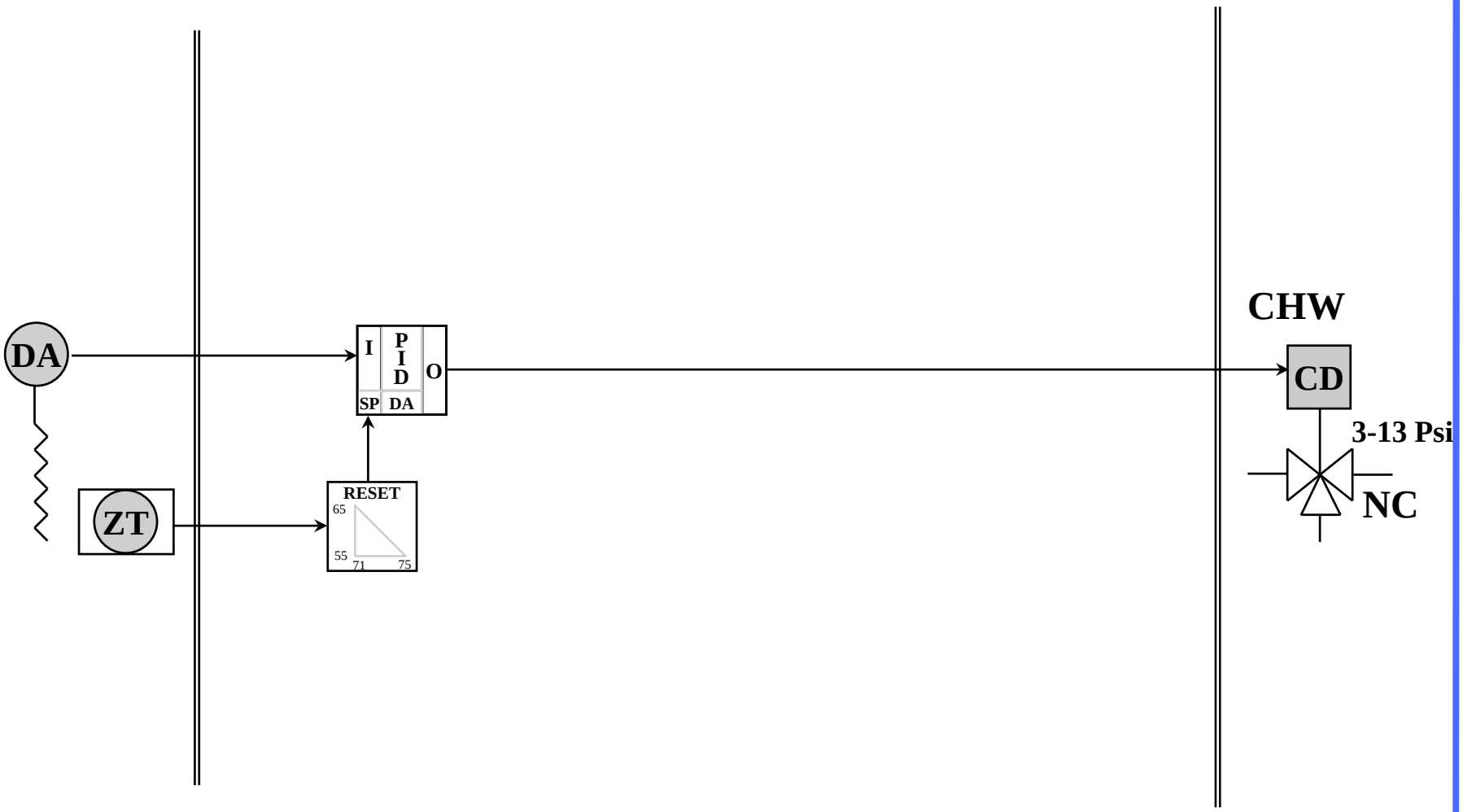


Zone Reset of Discharge Air

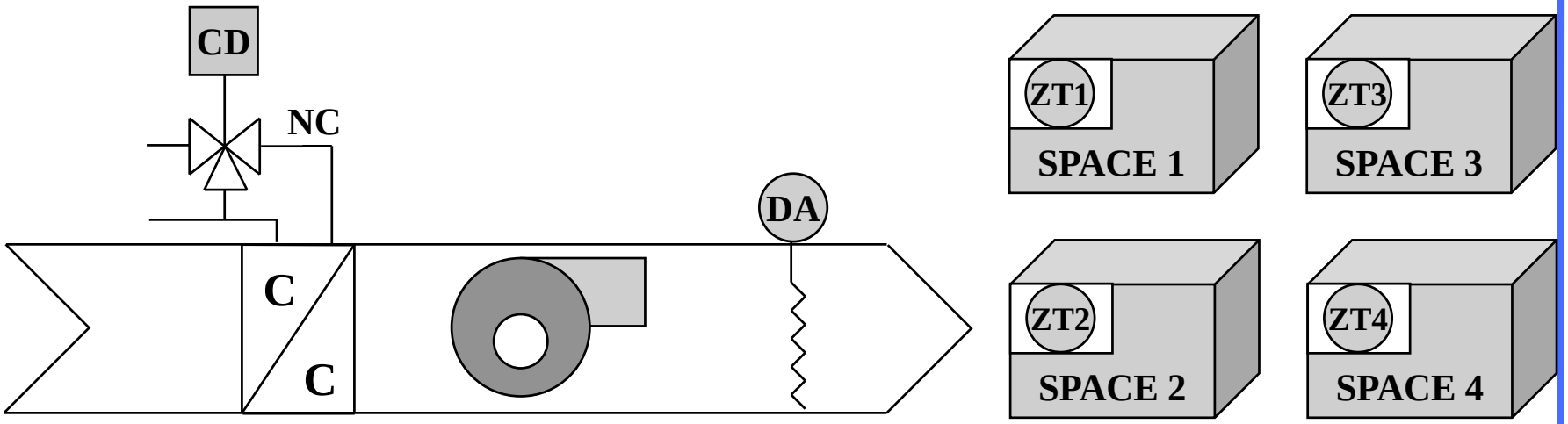


- Primary control loop is the discharge air
- The setpoint is reset as a function of the zone air temperature. This is a reverse reset application based on an closed loop variable. The Zone sensor does “feel” the effect of the control action.

Control Logic Diagram

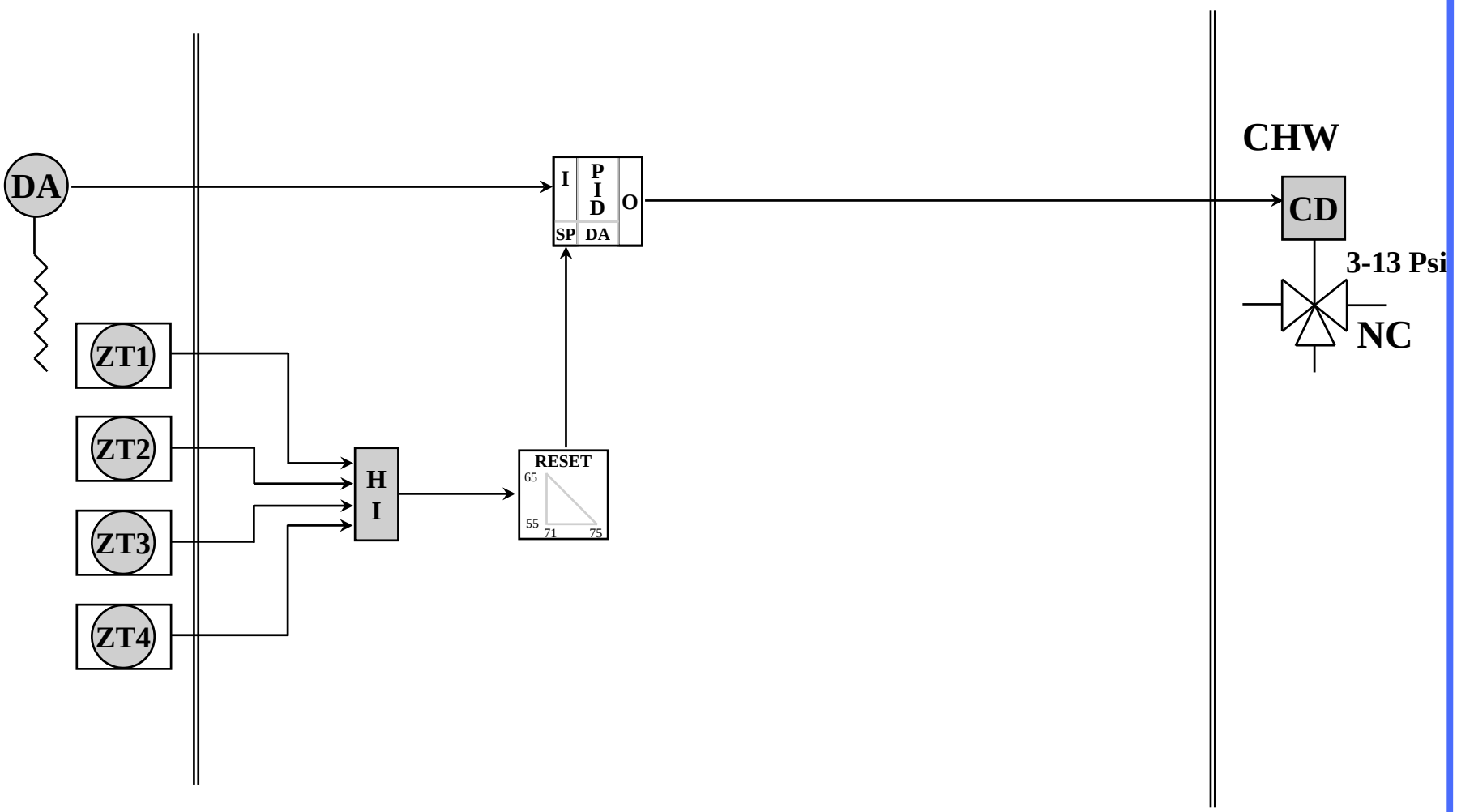


Discrimination Reset of Discharge Air

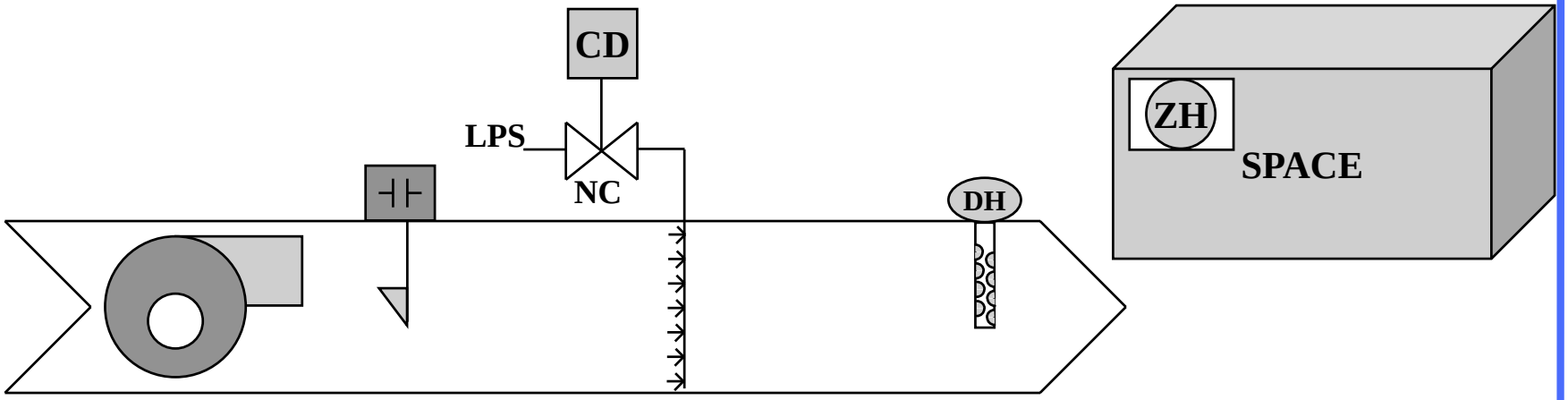


- Primary control loop is the discharge air
- The setpoint is reset as a function of the warmest zone air temperature. This application can be used with a small number of zones of a small number of representative zones.

Control Logic Diagram

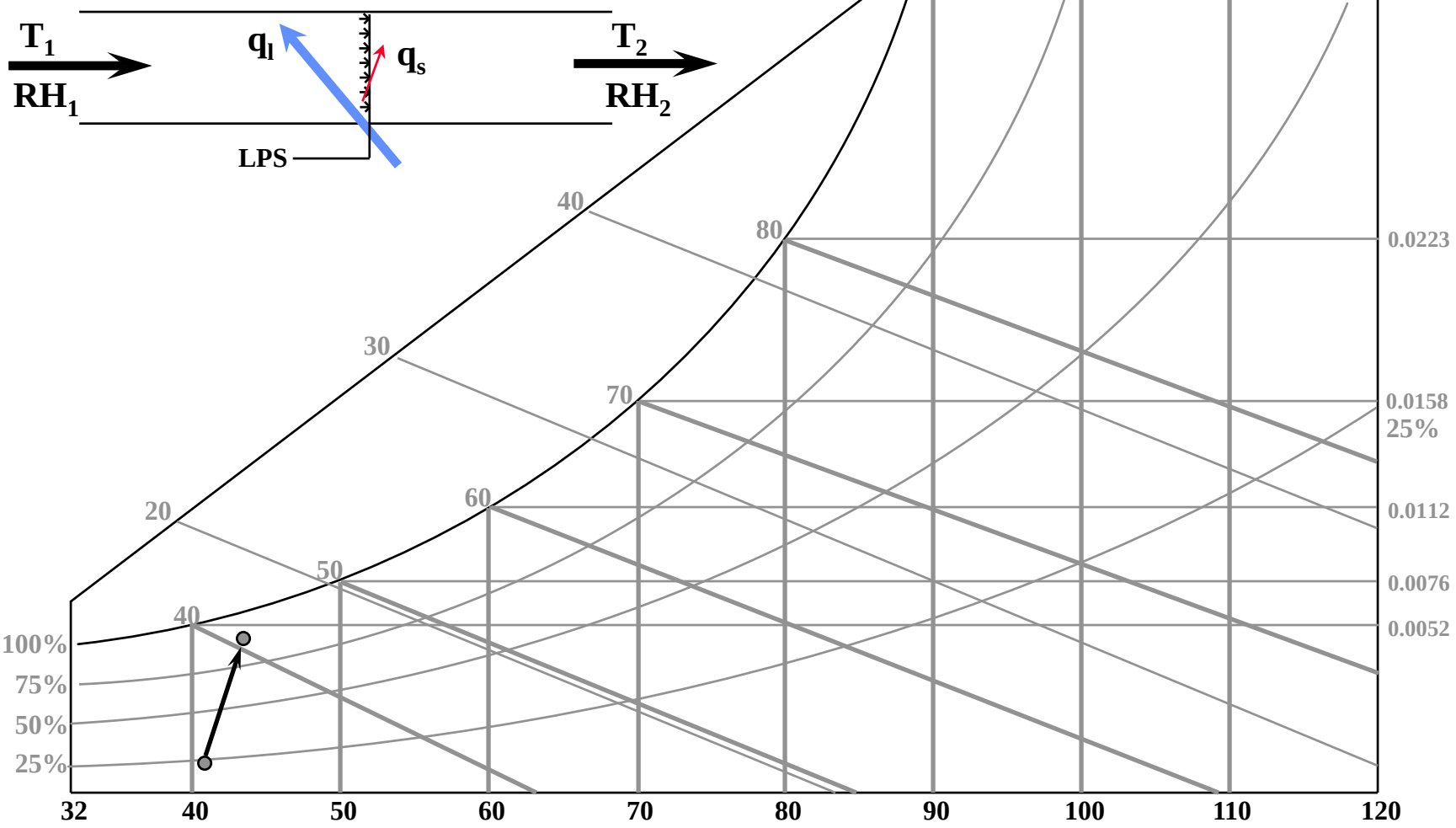


Humidification

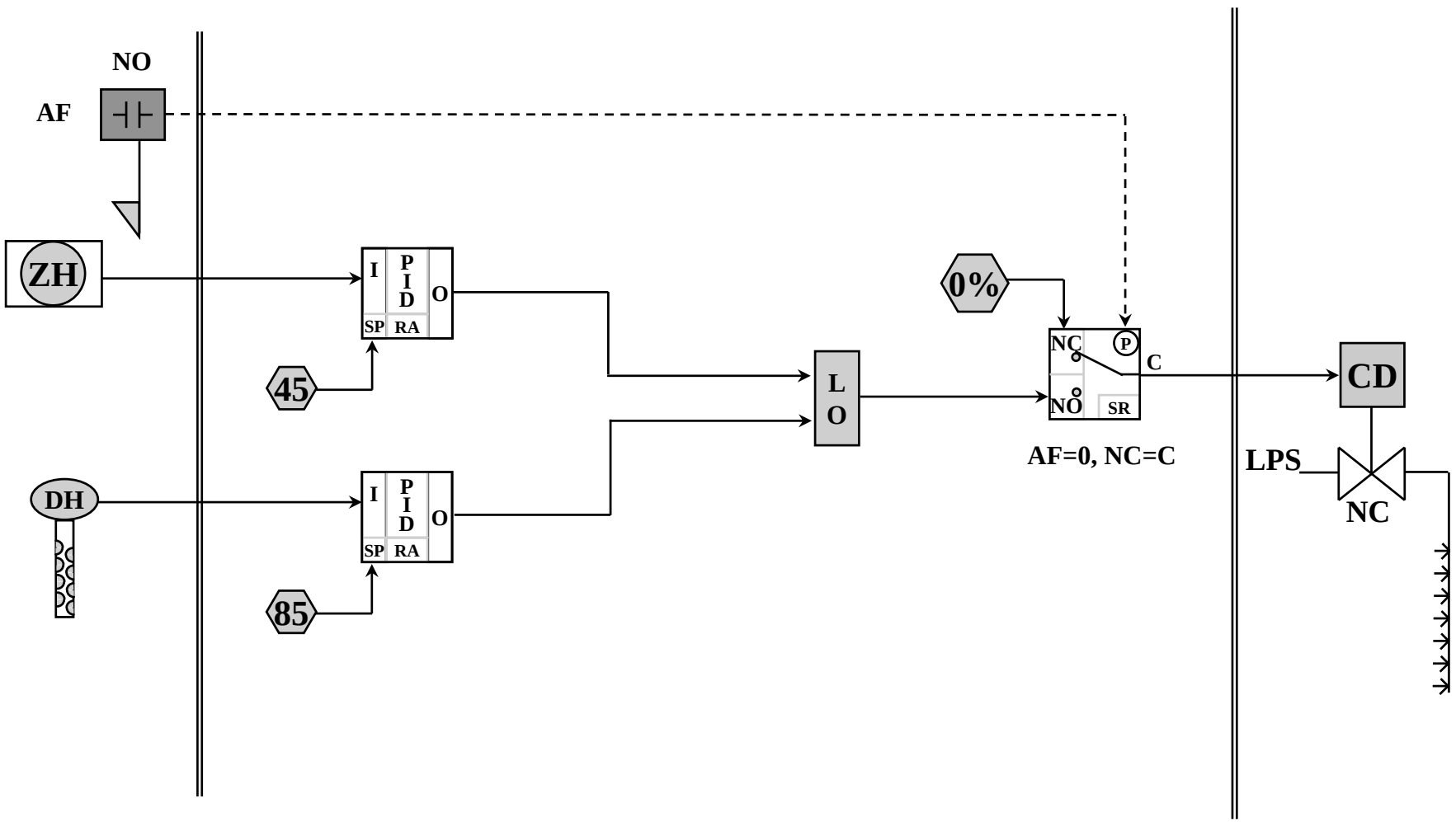


- The process involves proportional control of a NC steam valve to maintain space humidity
- A discharge humidity sensor is used to prevent saturation of supply air
- The fan must be proved on before steam valve opens

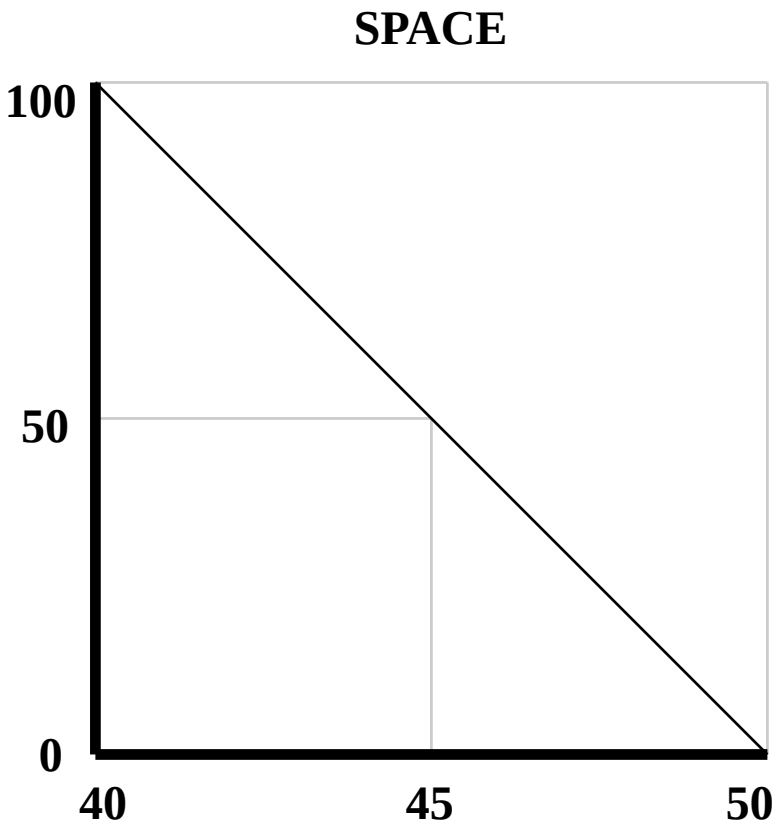
Humidification

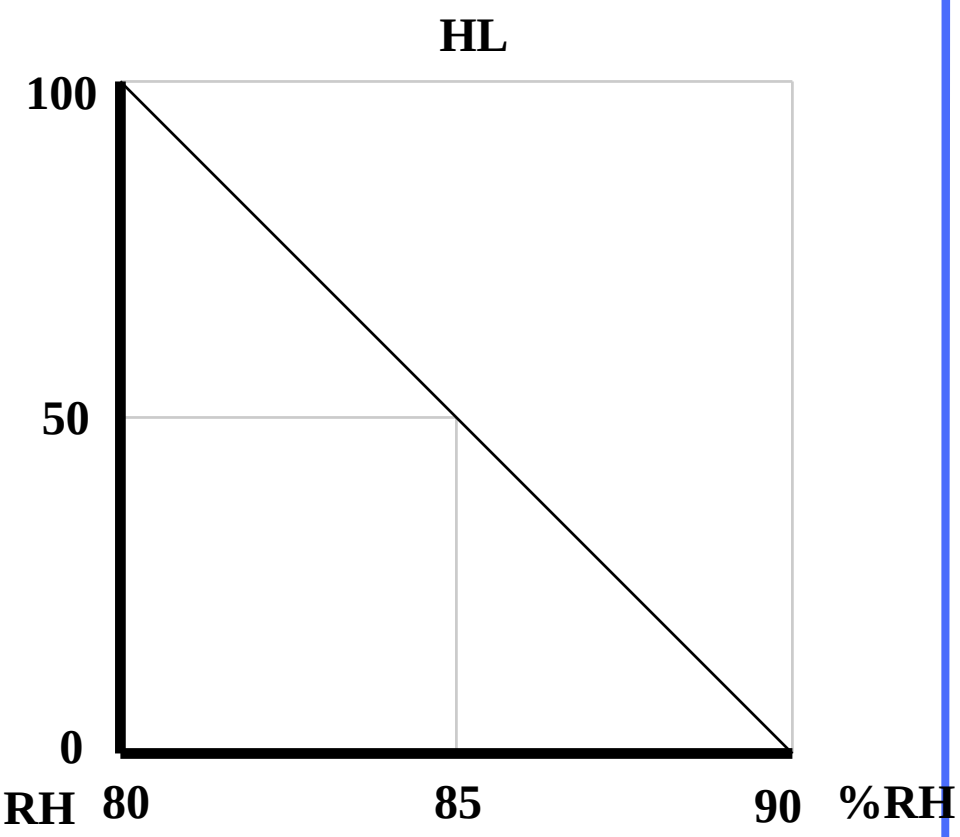


The Control Logic



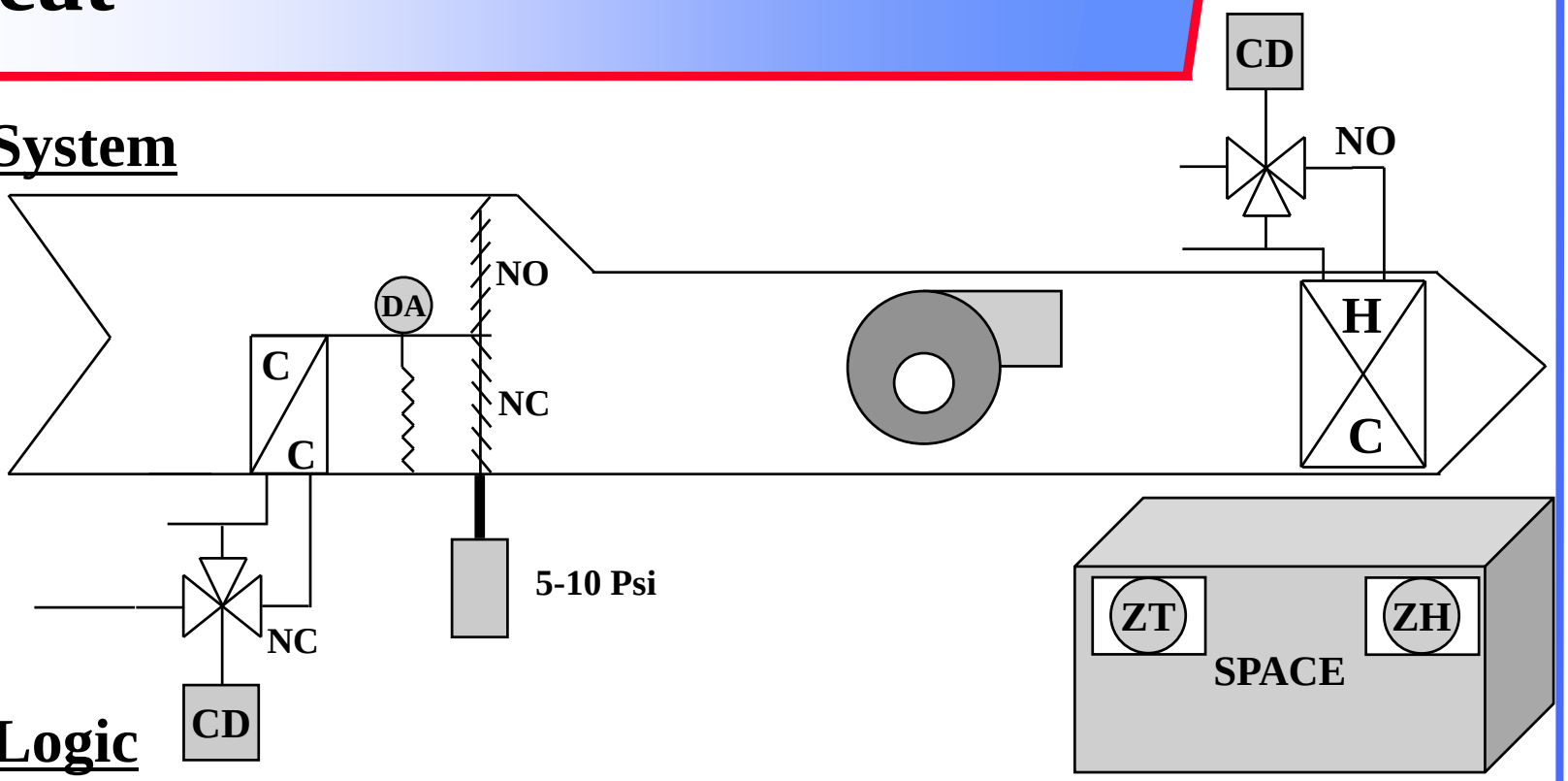
Performance Diagrams





Reheat

The System

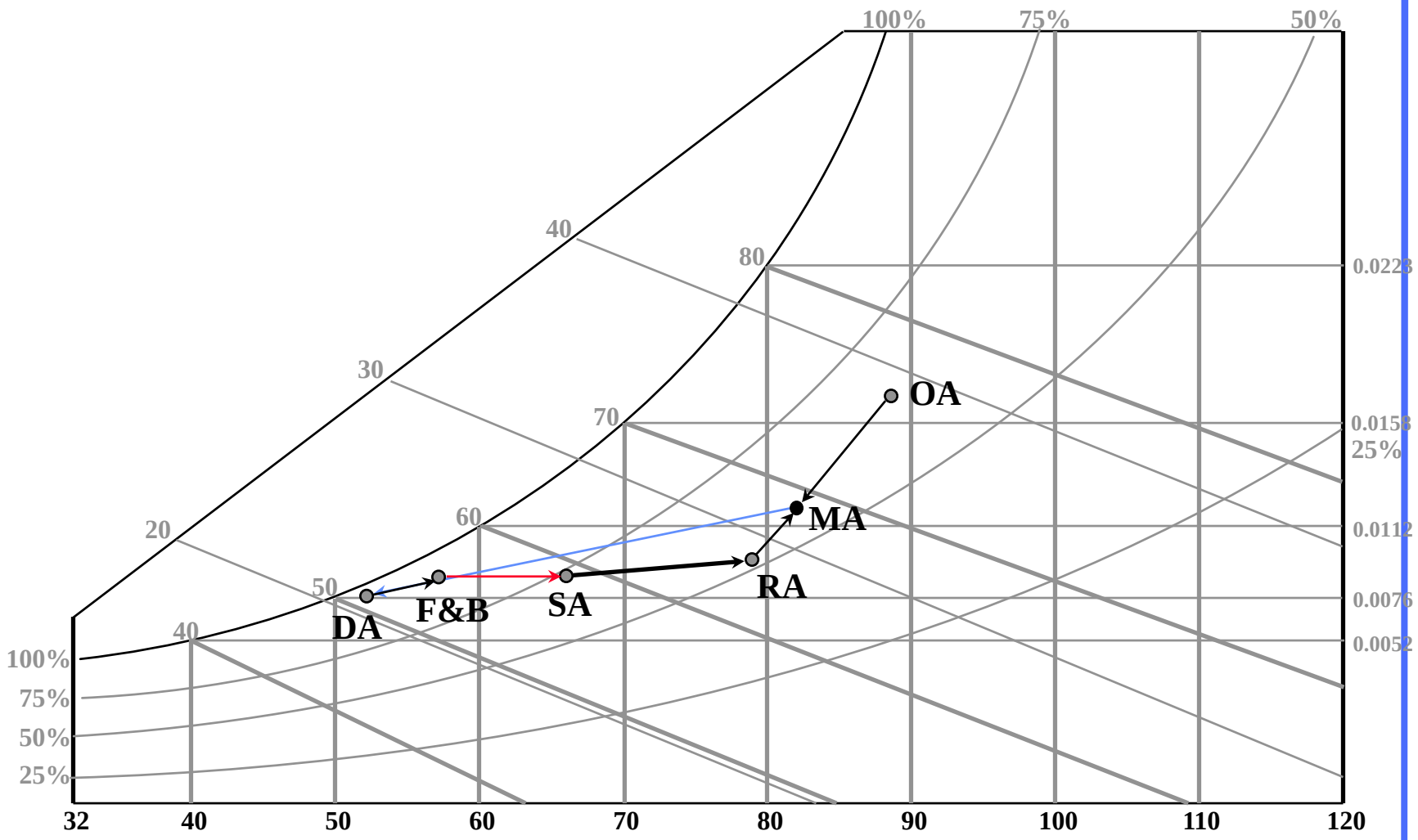


The Logic

The chilled water coil valve shall modulate to control a discharge air temperature of 52 degrees with a throttling range of 8 F.

The face and bypass dampers shall modulate more air across the cooling coil to maintain a space temperature of 72 F. +/- 2 F. or a space humidity of 50% RH +/- 5% RH air SP whichever demand is greater. The reheat coil valve shall modulate to maintain the 72 F. +/- 2 F. space temperature.

Reheat



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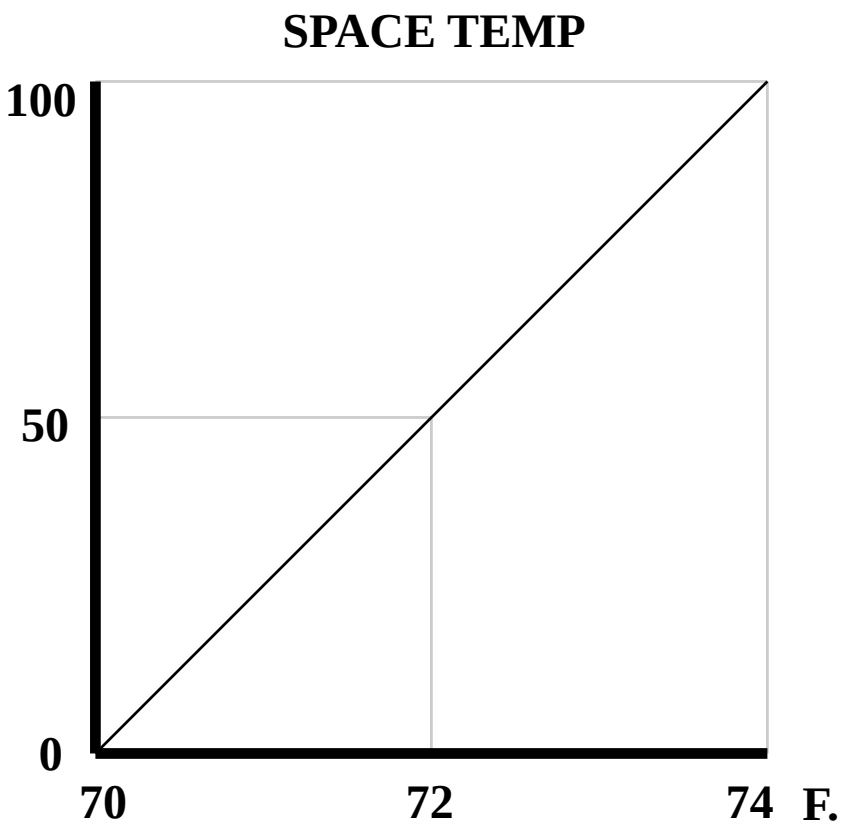
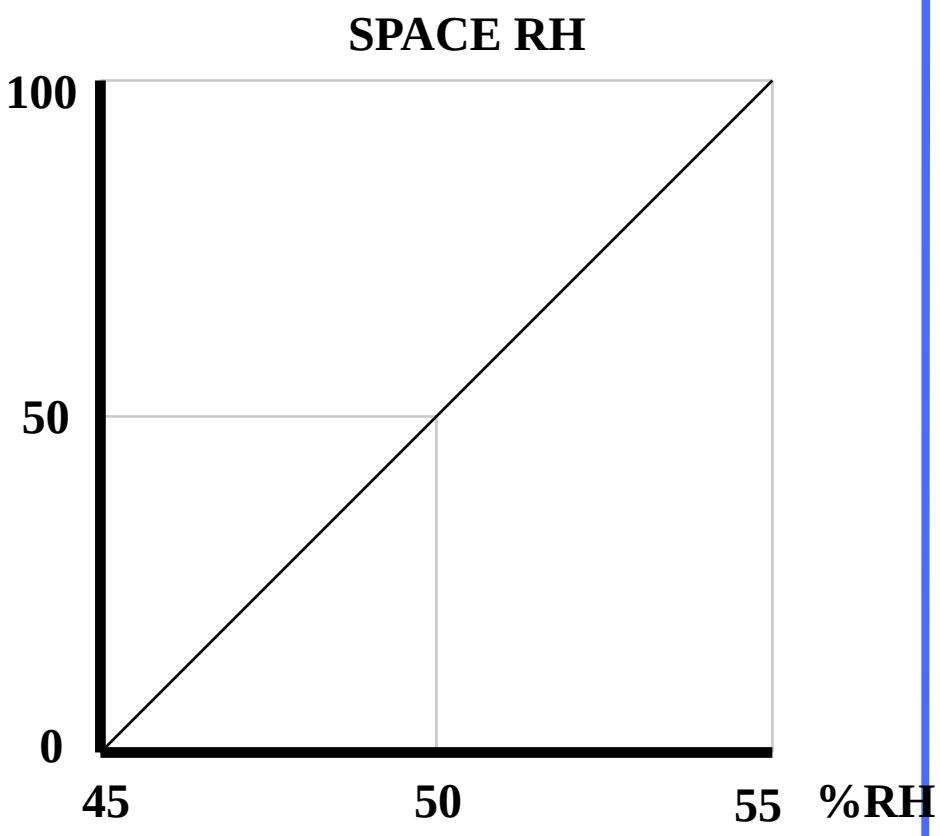
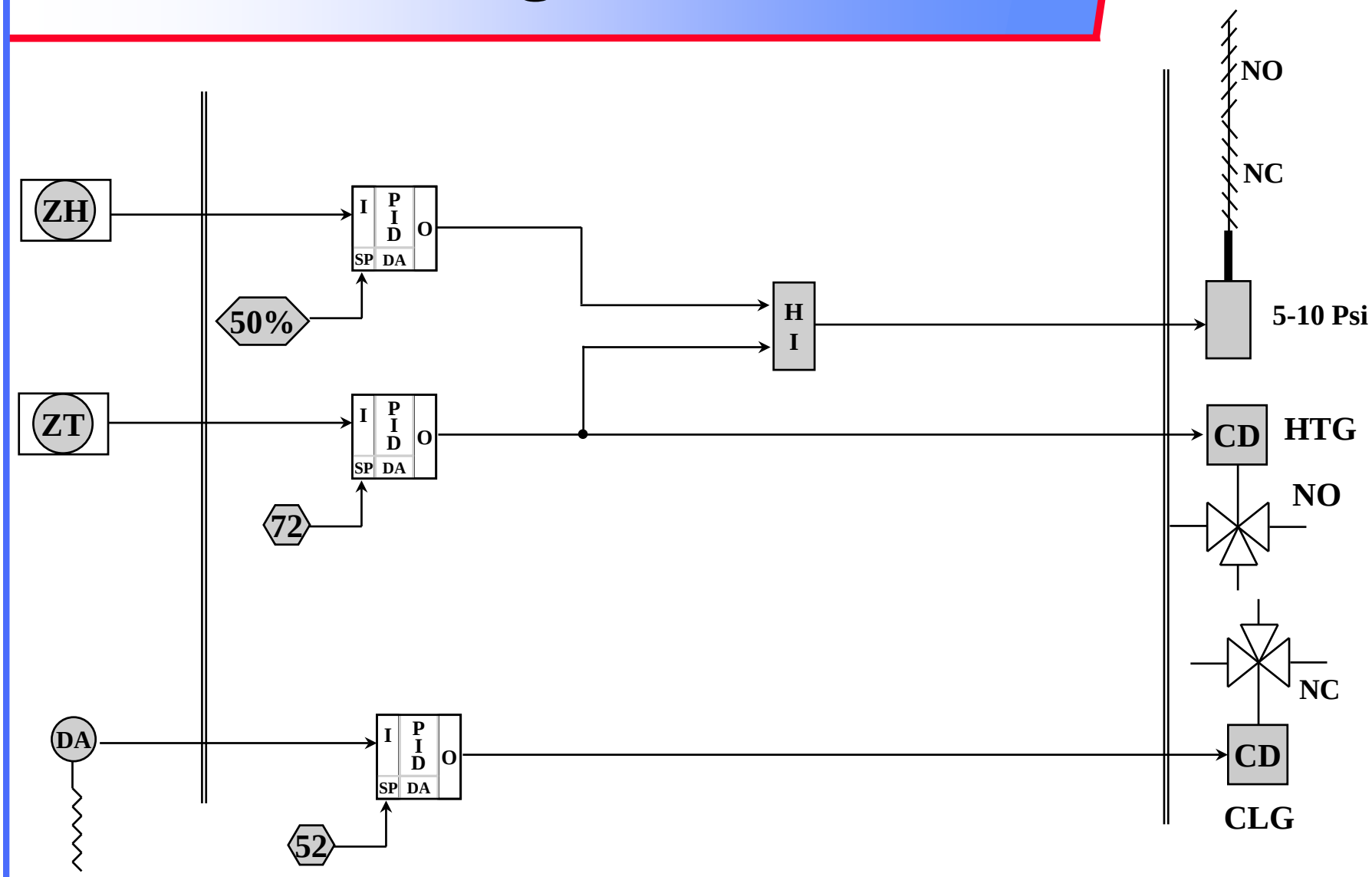


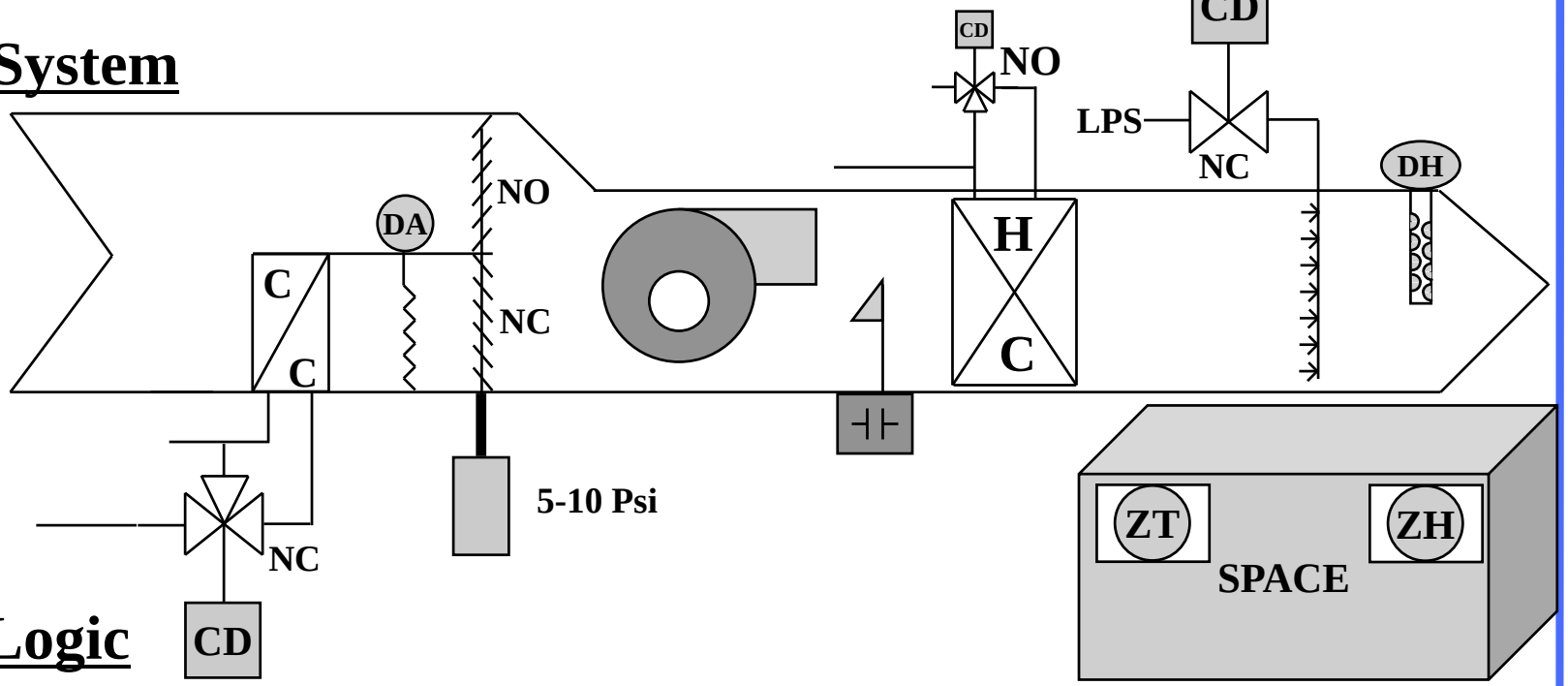


The Control Logic



Reheat with Humidification

The System



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The face and bypass dampers shall modulate more air across the cooling coil to maintain a space temperature of 72 F. +/- 2 F. or a space humidity of 50% RH +/- 5% RH air SP whichever demand is greater. The reheat coil valve shall modulate to maintain the 72 F. +/- 2 F. space temperature. The humidifier steam valve shall modulate to control a space humidity of 50% RH +/- 5 %RH. The valve shall close on a rise of discharge humidity above 85% or if there is no air flow.

The Control Logic