

Pumps (and Piping)

Design, Performance and Commissioning Issues

Open and Closed Systems



Instructor:

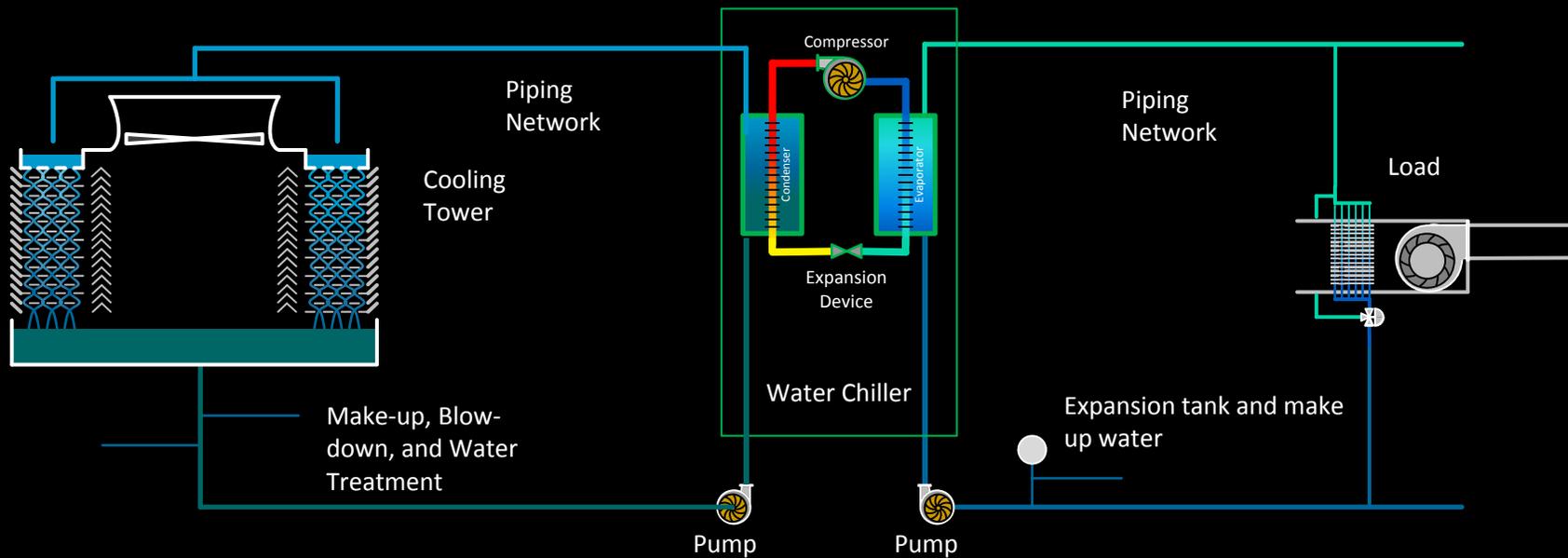
David Sellers

Senior Engineer

Facility Dynamics Engineering

April 4, 2017

Central Plants Typically Have Open and Closed Systems Associated with Them



Typically an open system

More than one interface with the atmosphere or a compressible gas

Typically a closed system

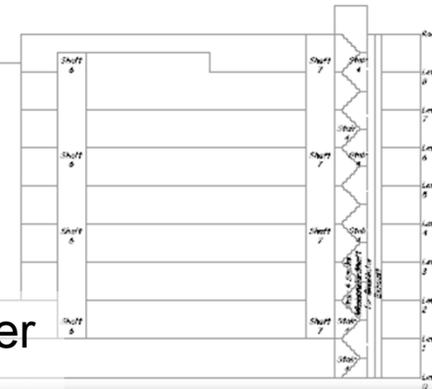
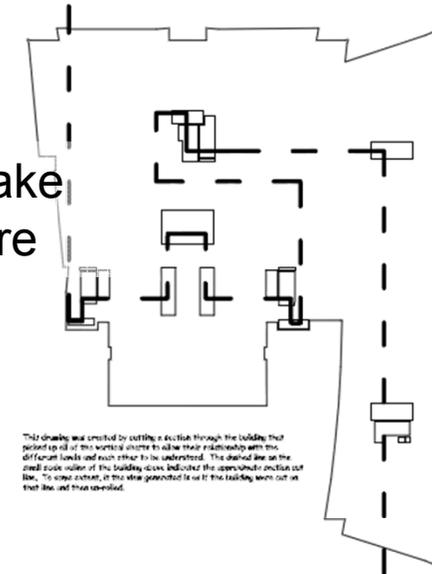
Only one interface with atmosphere or a compressible gas

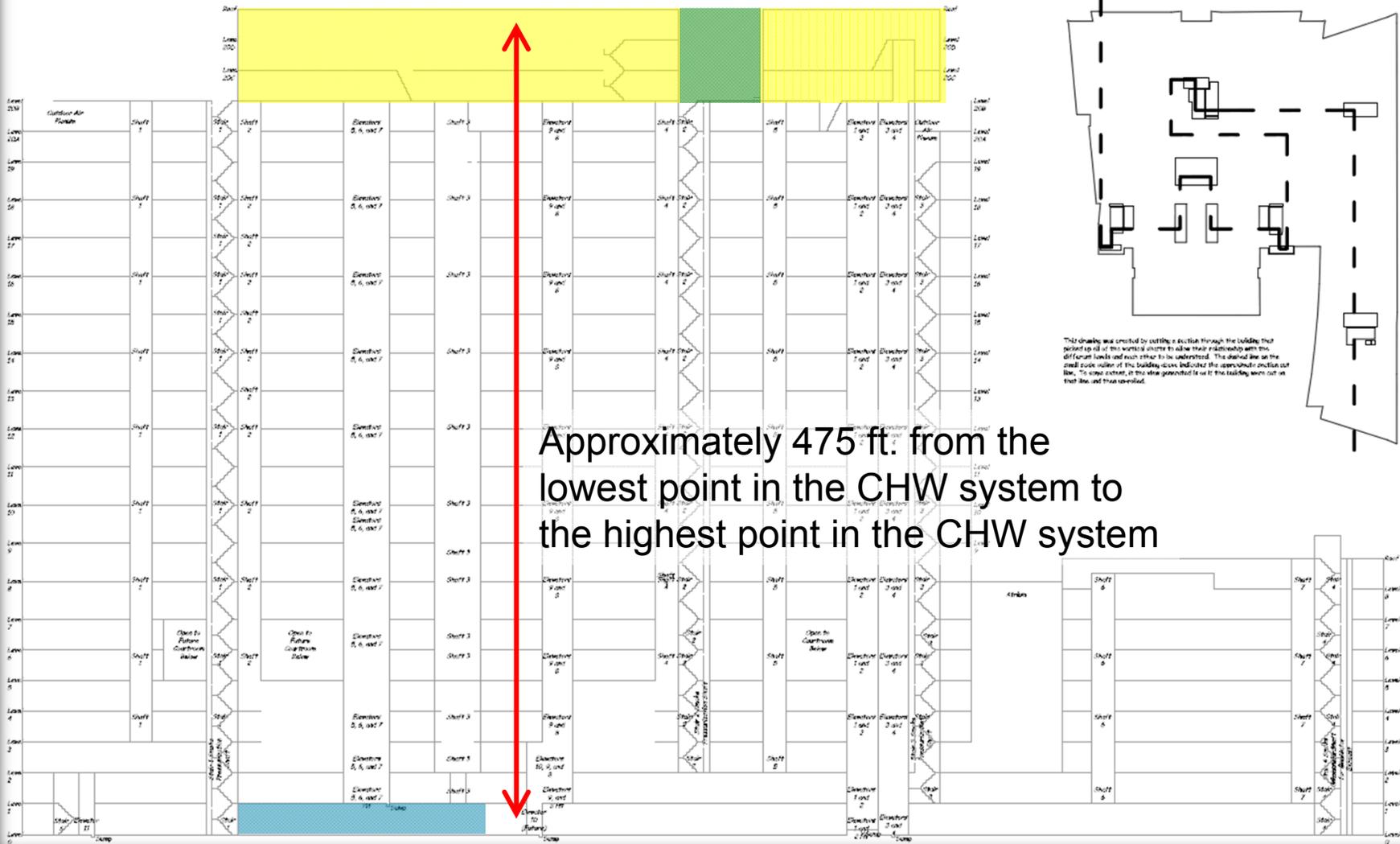
Air handling units
are here

Cooling towers and make
up connections are here

Piping mains run up
and down this chase

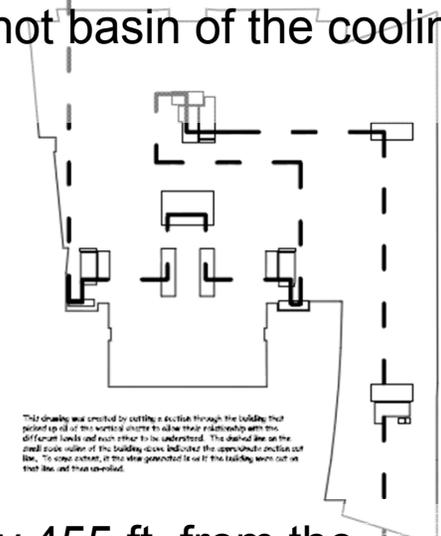
Chillers, pumps, and chilled water
make up connection here





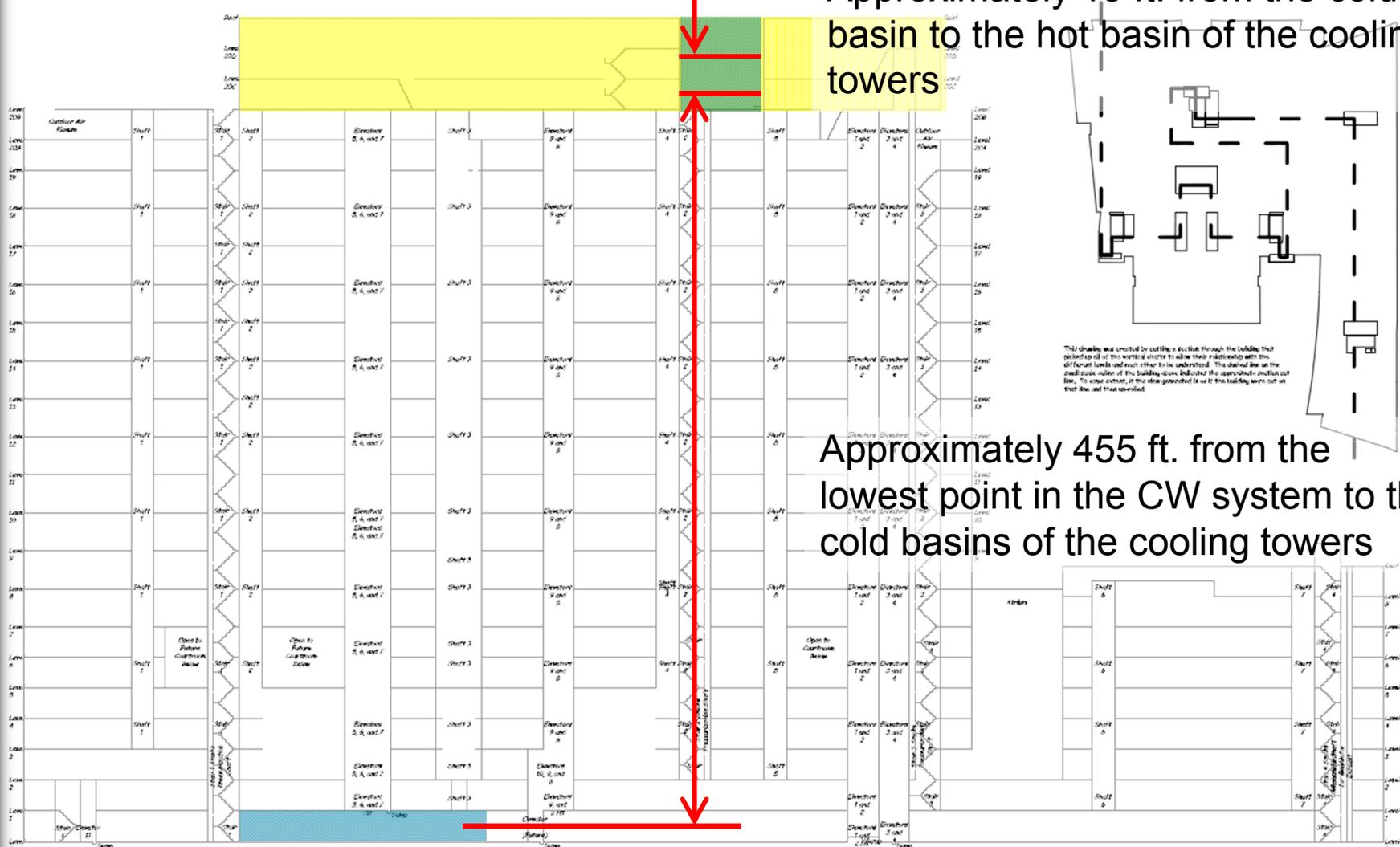
This drawing was created by cutting a section through the building that picked up all of the working systems to allow their relationship with the different levels and each other to be understood. The dashed line on the small scale plan of the building shows the approximate section cut line. To some extent, in the view generated to use in this building, were cut in their line and then overlaid.

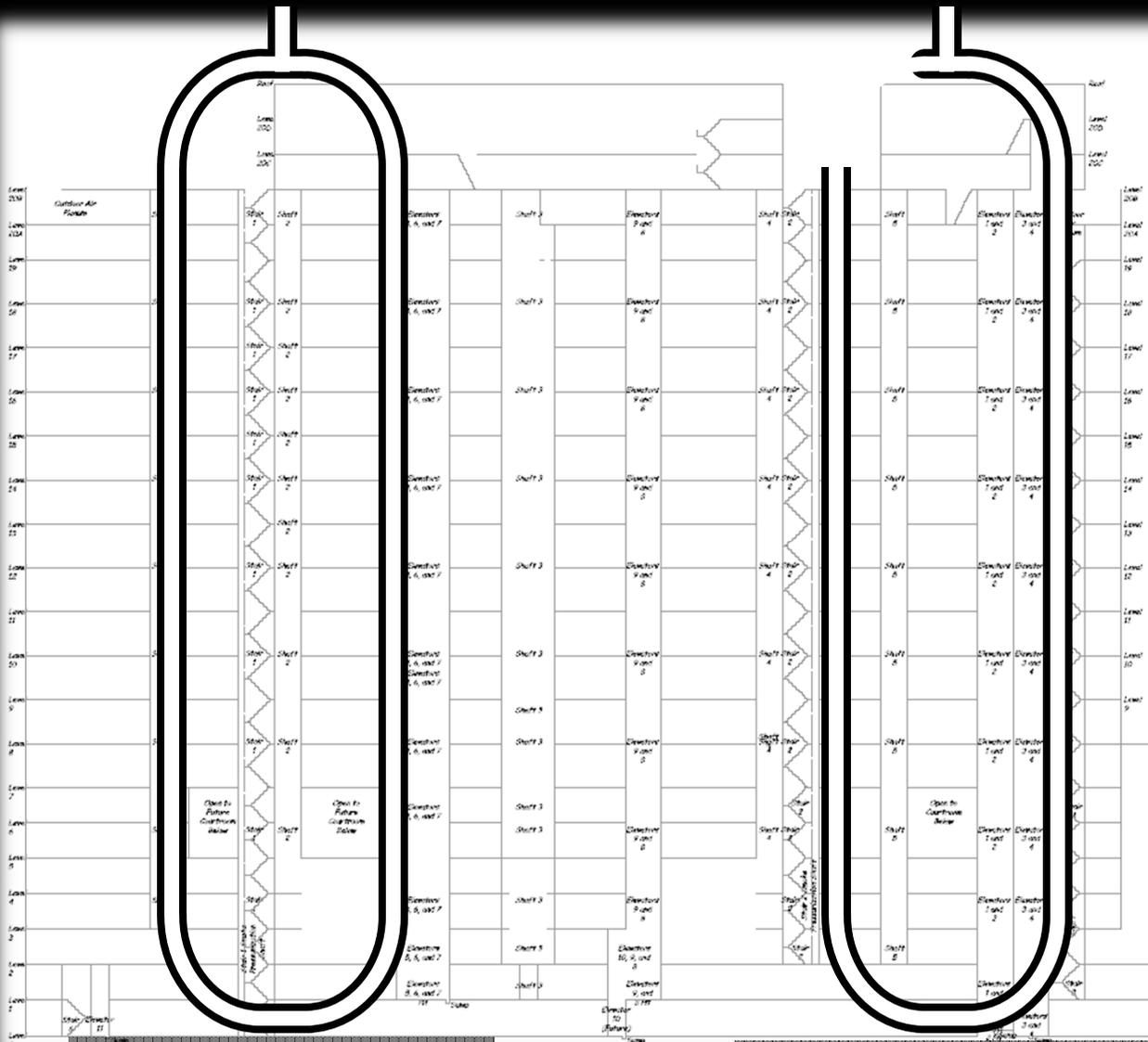
Approximately 15 ft. from the cold basin to the hot basin of the cooling towers



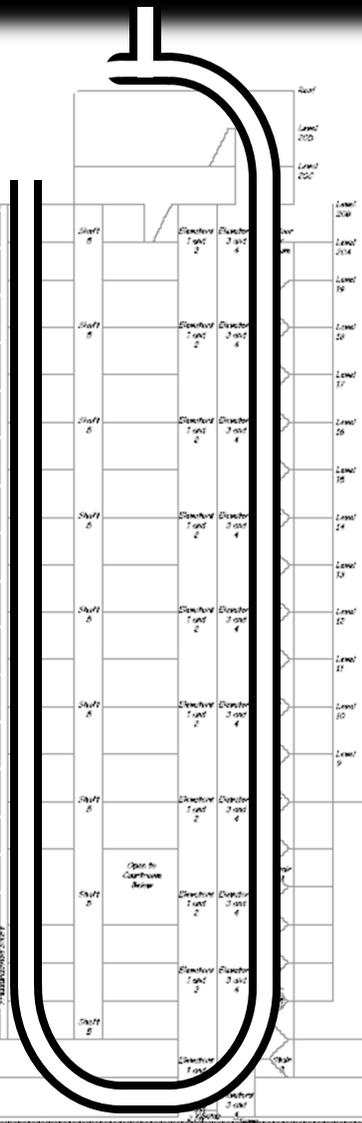
This drawing was created by cutting a section through the building that passed up all of the working shafts to allow their relationship with the different levels and room sizes to be understood. The dashed line on the small scale plan of the building shows the approximate section cut line. To avoid clutter, the view generated is as if the building were cut in front view and then reassembled.

Approximately 455 ft. from the lowest point in the CW system to the cold basins of the cooling towers

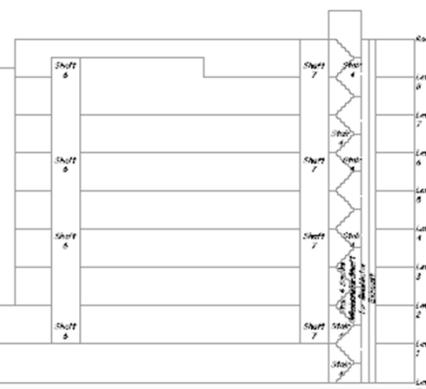
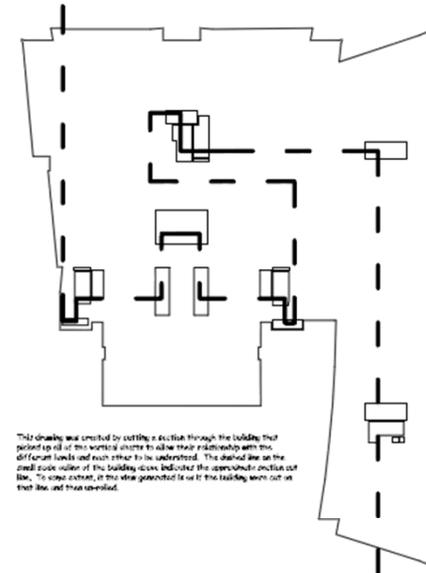


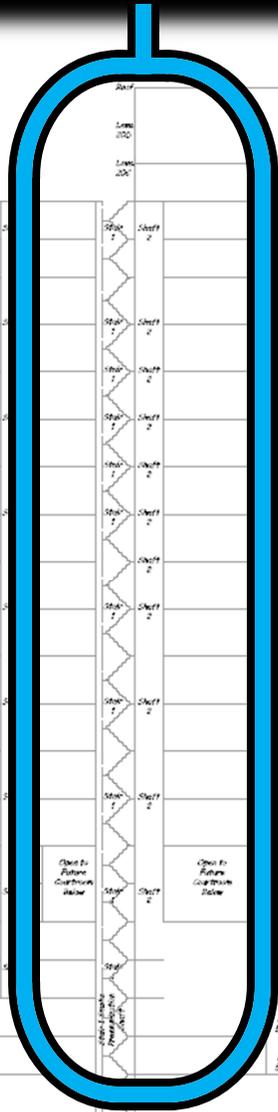


Closed Chilled Water System



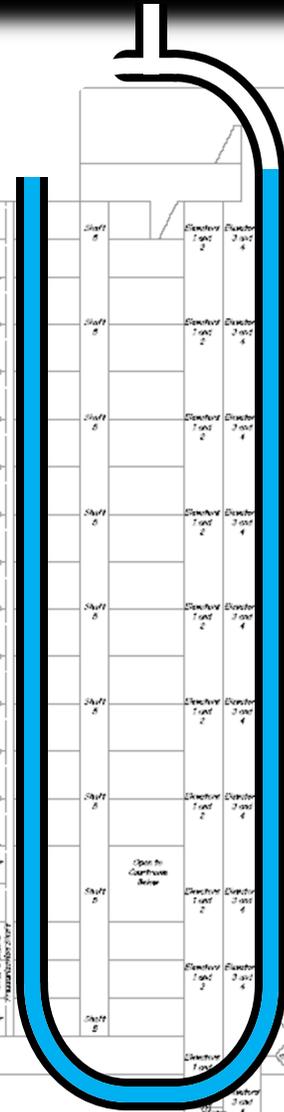
Open Condenser Water System





The closed chilled water system could be completely filled from a connection at the high point in the system

Closed Chilled Water System

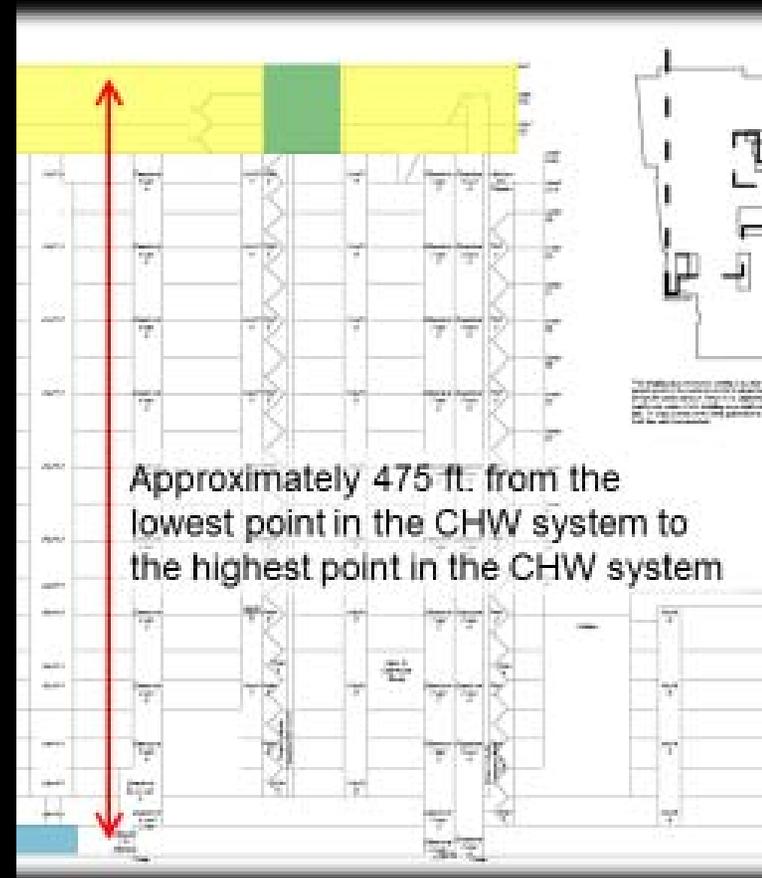


The open condenser water system could only be filled to the rim of the open basin from a connection at the high point in the system

Open Condenser Water System

A Couple of Questions

- What pressure should be used as a fill pressure for the chilled water system and why?



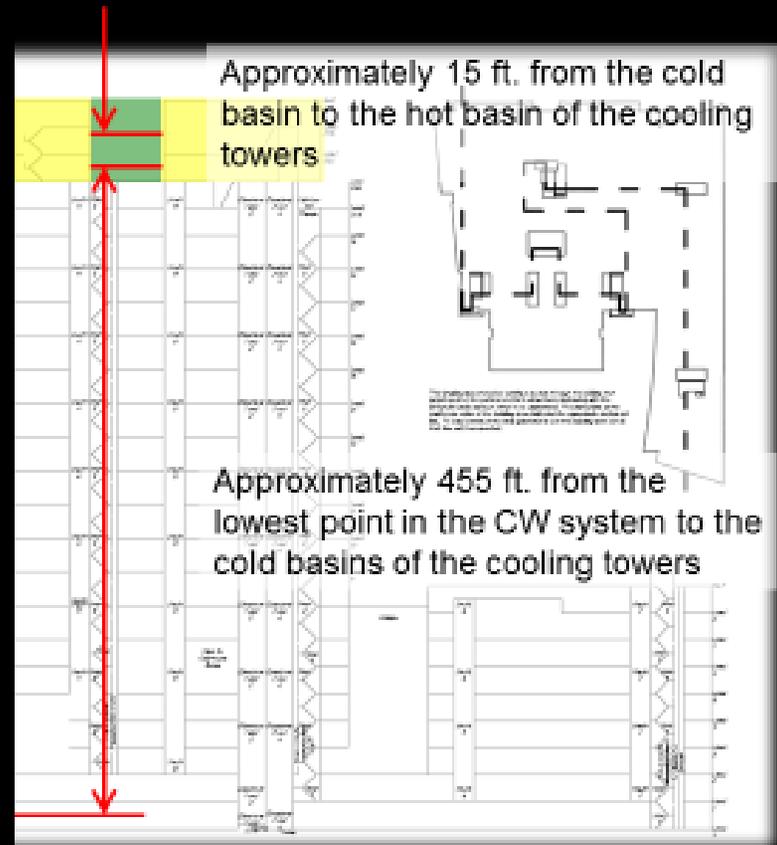
A Couple of Questions

- What pressure should be used as a fill pressure for the chilled water system and why?
- If the evaporator pumps serving the chillers are rated to produce 30 ft.w.c. of head at design conditions, what would an appropriate range be for the pressure gauges on the pump?

Standard Ranges			
psi Ranges (A)			
Range Code	Specific Range (psi)	Figure Intervals	Minor Divisions
010	30" Hg to 0	5	0.2
020	30" Hg to 15 psi	5/5	0.5/0.2
030	30" Hg to 30 psi	10/5	1/0.5
040	30" Hg to 60 psi	10/10	1/1
050	30" Hg to 100 psi	30/10	2/1
060	30" Hg to 150 psi	30/20	5/2
070	30" Hg to 300 psi	30/50	5/2
080	0 to 15 psi	3	0.1
090	0 to 30 psi	5	0.2
100	0 to 60 psi	10	0.5
110	0 to 100 psi	10	1
120	0 to 160 psi	20	1
130	0 to 200 psi	20	2
140	0 to 300 psi	50	2
150	0 to 400 psi	50	5
160	0 to 600 psi	50	5
180	0 to 1000 psi	100	10

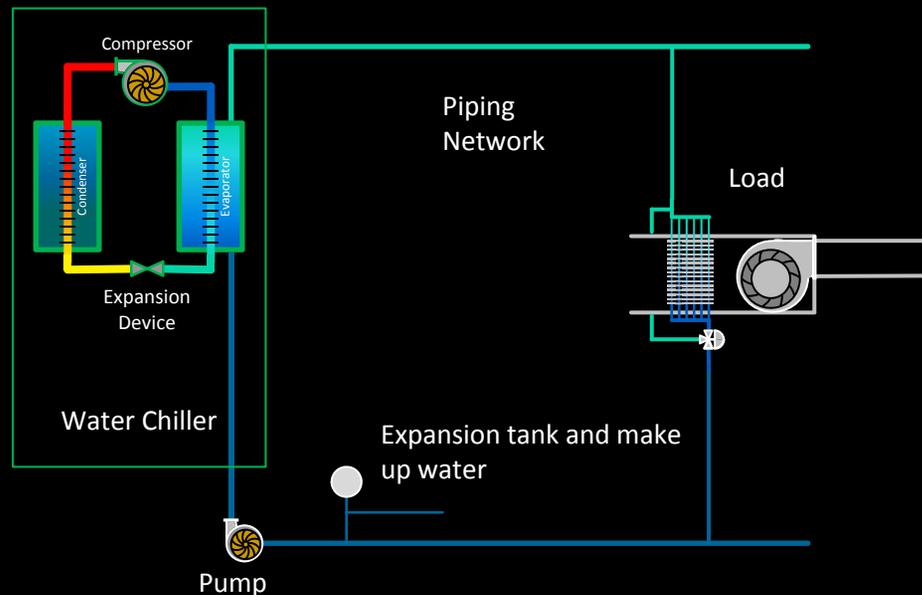
Some More Questions

- How much head needs to be included in the condenser water pump selection to lift water through an elevation change?
- Assuming the condenser pump is at the lowest point in the system, what would the gauge on its suction connection read when the system was not operating?
- Would this reading change when you started the pump?



Closed Systems

- Interface is at the expansion tank
 - Open or diaphragm type
 - Different sizing issues
 - Different piping issues
- Pressure tends to hold constant at the expansion tank
- Expansion tank typically at the distribution pump suction connection
- Air separation may or may not be at the expansion tank
- Fill pressure needs to be sufficient to vent air at high points



- Make up typically connected at the expansion tank
 - Very little required once filled
 - Limited water treatment
 - Monitor volume and pressure



Non-Diaphragm
Expansion Tank

Diaphragm Expansion Tank



Air Separators



Makeup Connections

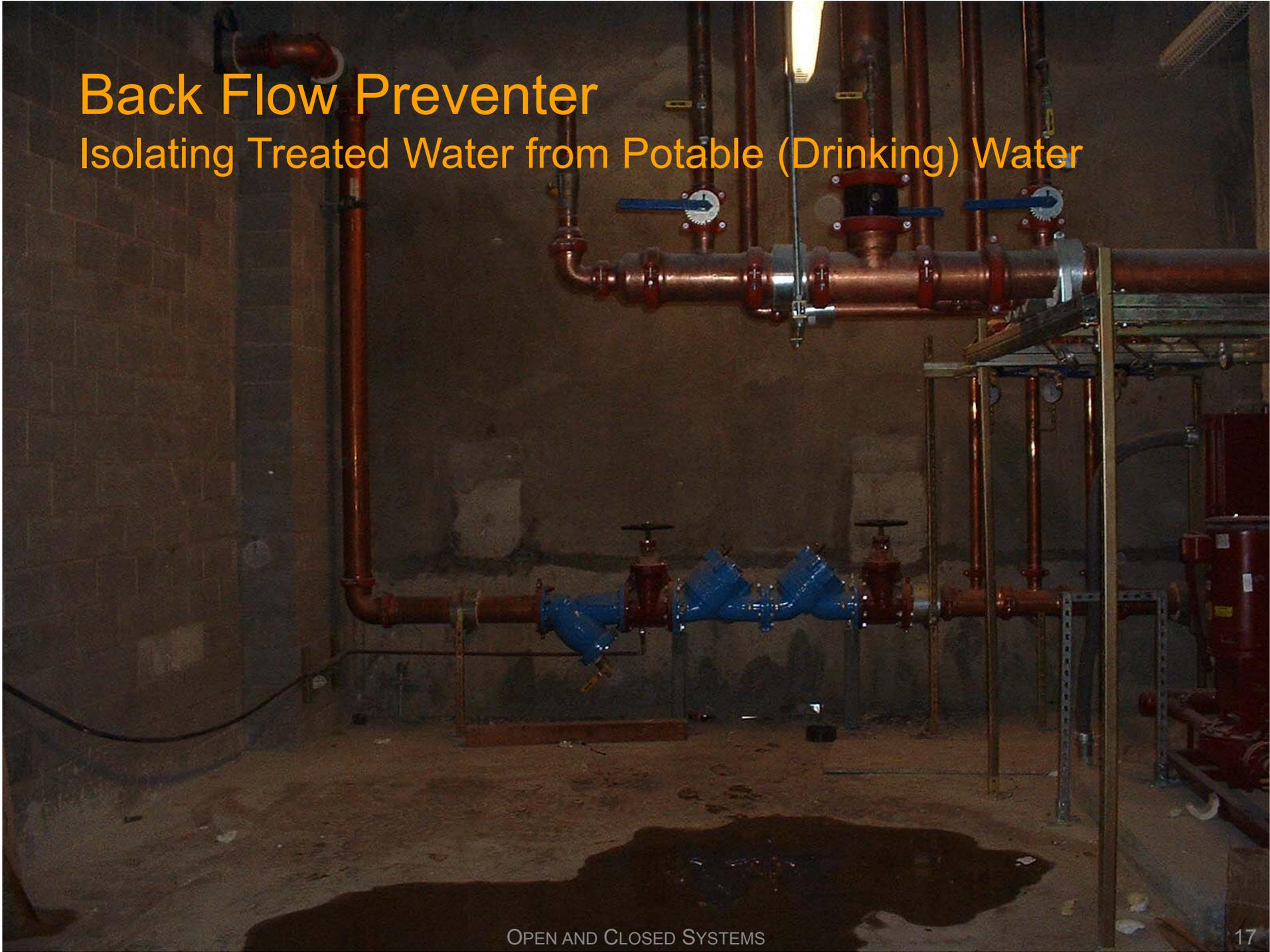


Water Treatment via Shot Feeder



Back Flow Preventer

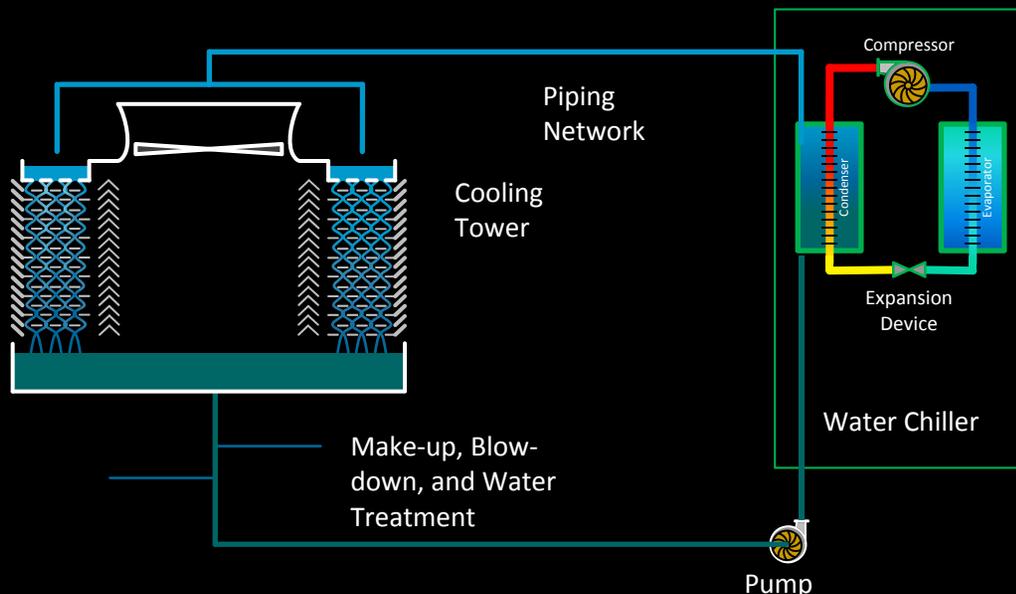
Isolating Treated Water from Potable (Drinking) Water



Back Flow Preventer Isolating Treated Water from Potable (Drinking) Water



Open Systems



- Water treatment requirements more significant
- Chilled and hot water systems can be open systems

- Interfaces are at the cooling tower return and supply points
 - Cold water typically connected to a sump or cold basin
 - Hot water distributed by spray nozzles or orifices in a “hot basin”
- Pump head must lift the water between the basins
- Make-up requirements more significant
 - Evaporation
 - Blow-down

Water Treatment



Side Stream Filtration





Cooling Tower Make-up Piping and Meter

Cooling Tower Blow-down Piping and Meter



Cooling Tower Opportunity

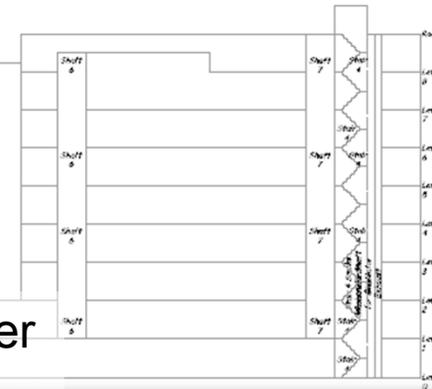
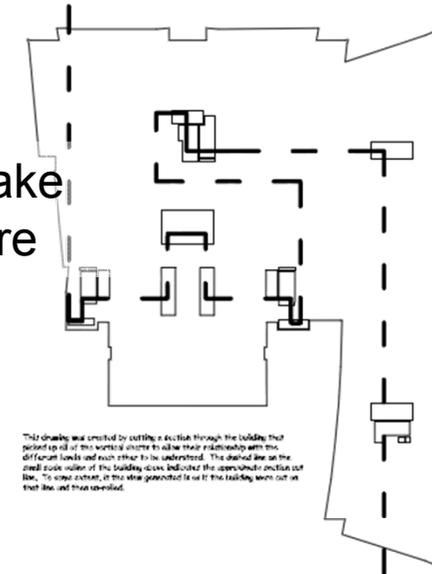
http://youtu.be/EVtO-y_NKN8

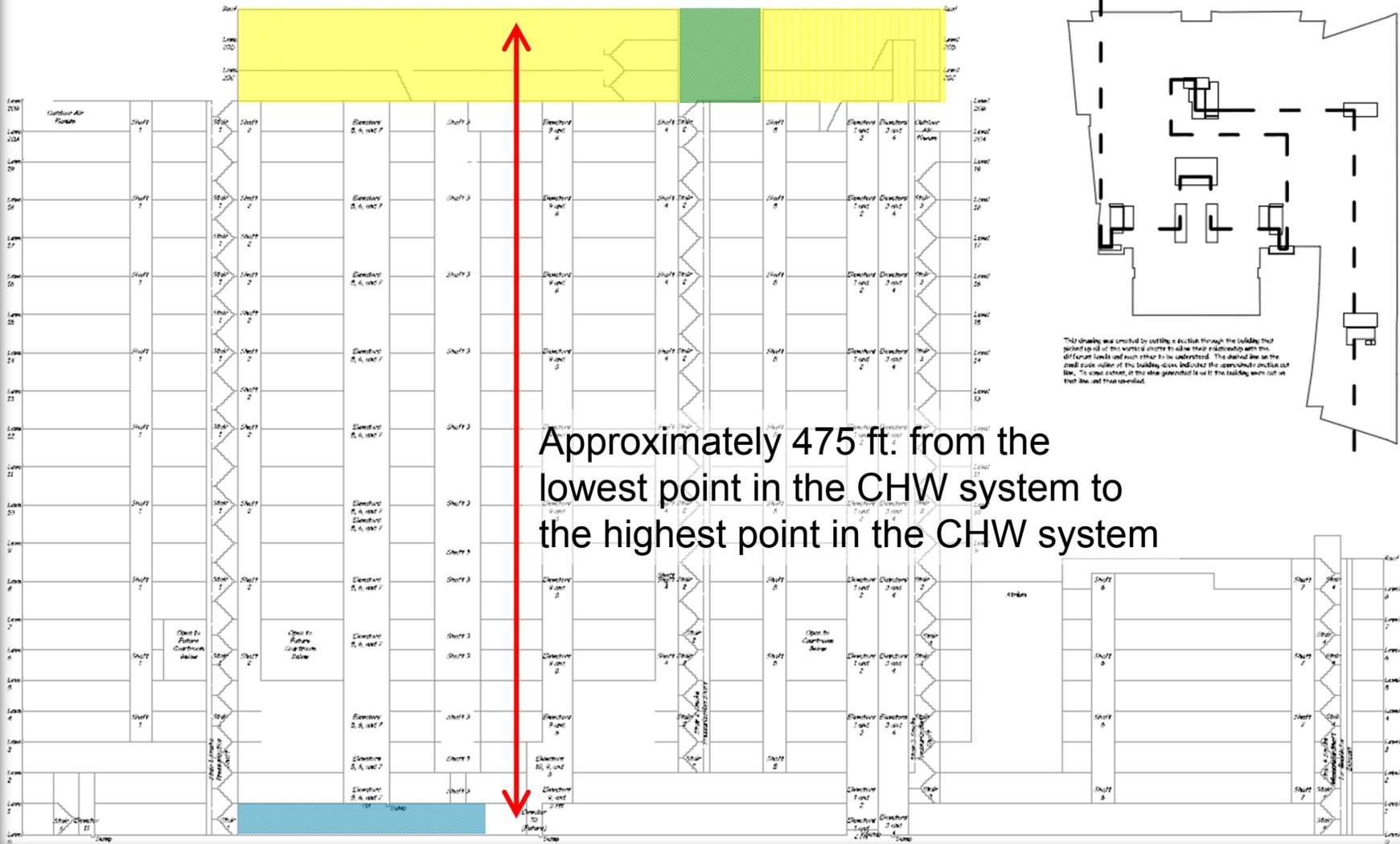
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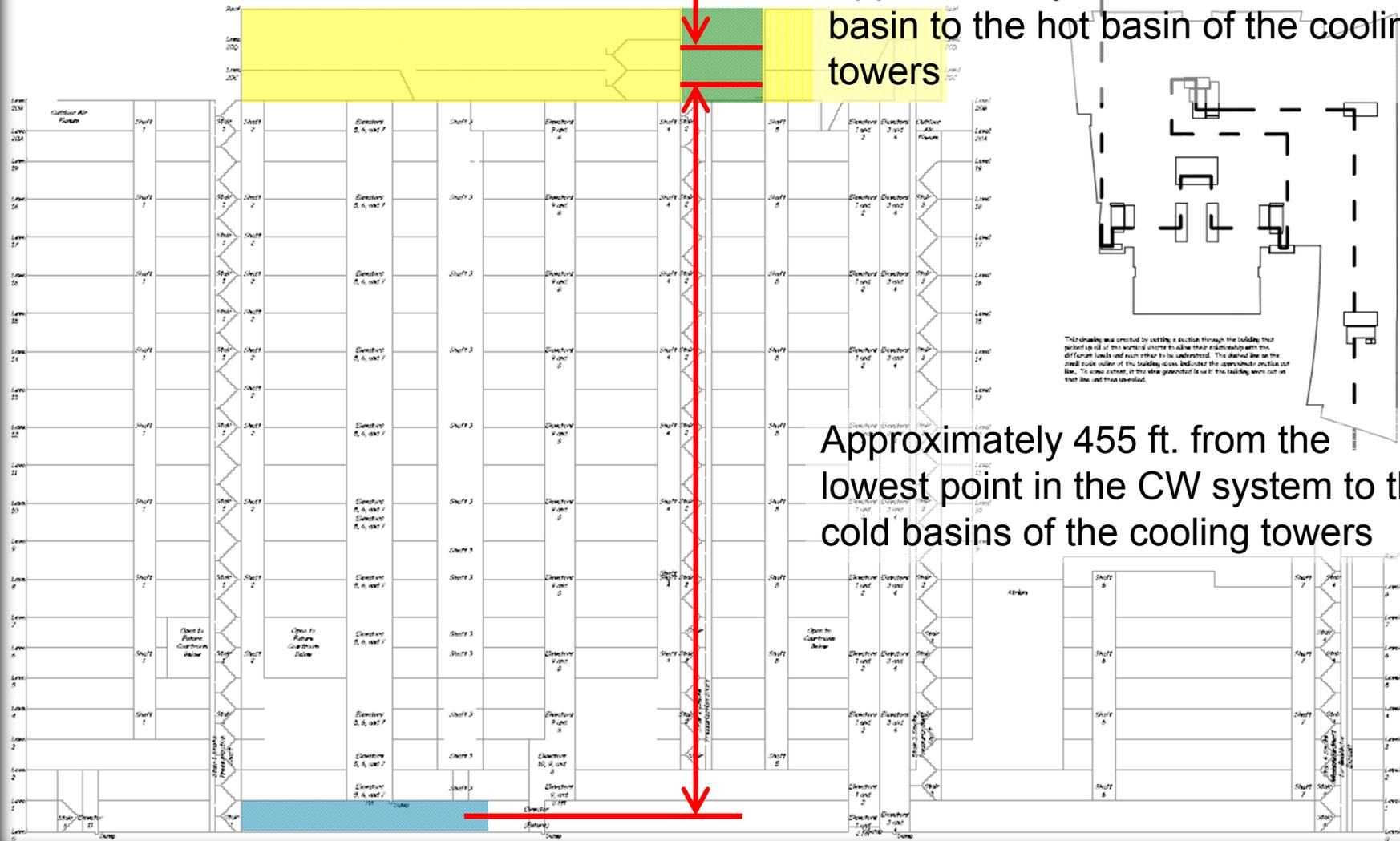
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