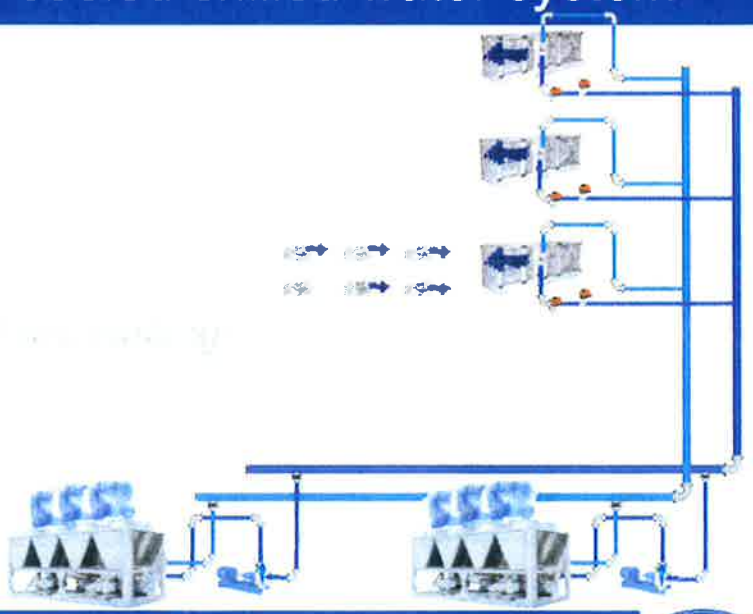
Various Chilled-water Plant Configurations

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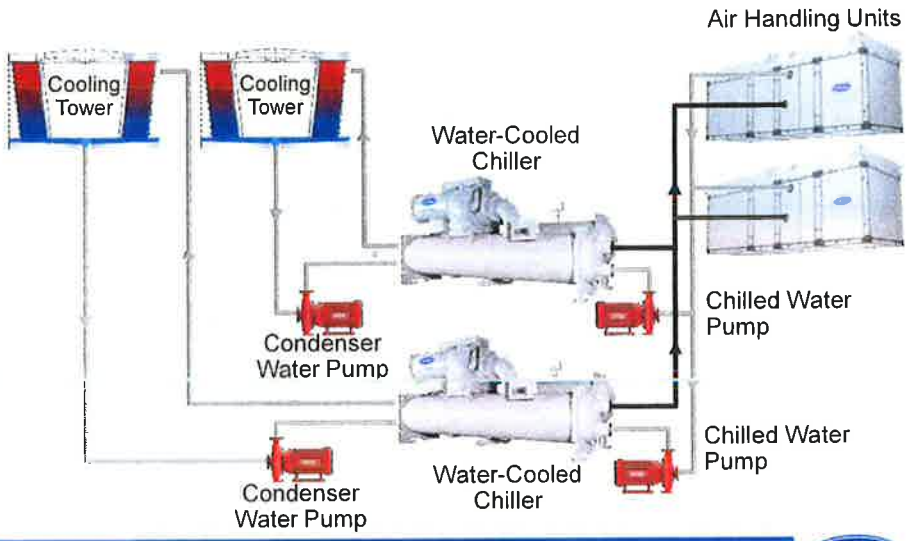
Air-cooled chilled-water system



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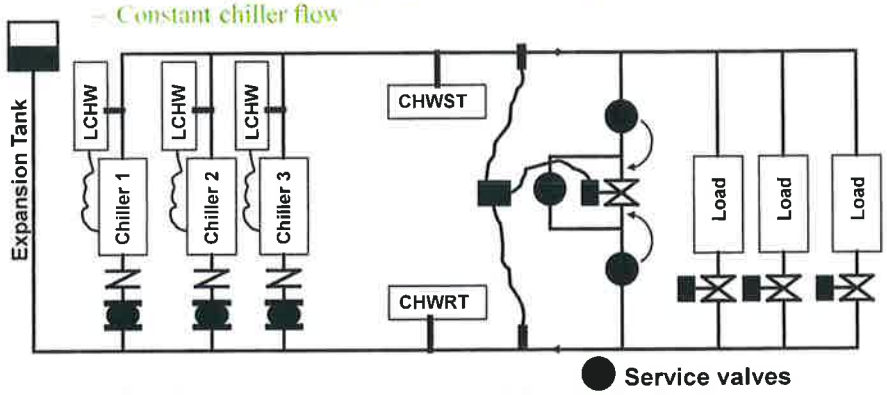
Multiple Chiller Dedicated Pumps



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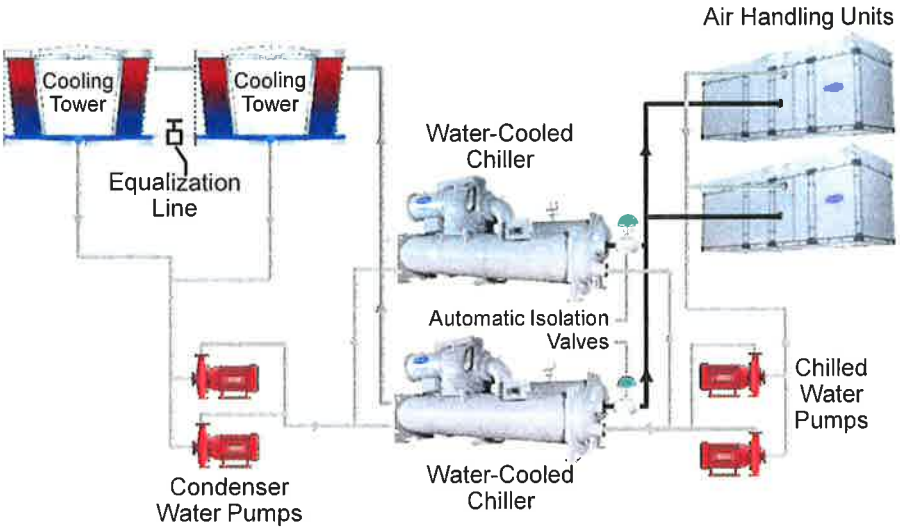
Differential bypass

- Bypass maintains constant header differential
- Locate bypass and sensors as far *downstream* as possible
  - Maximize portion of piping under constant pressure
  - Constant chiller flow



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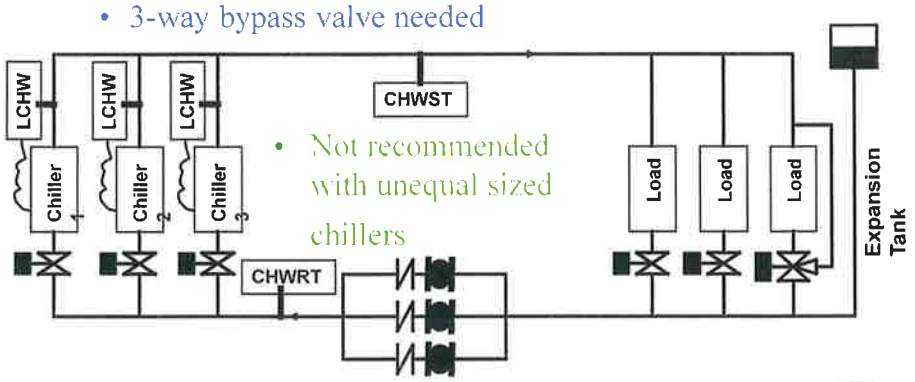
Multiple Chiller Manifolded Pumps



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Parallel pumps

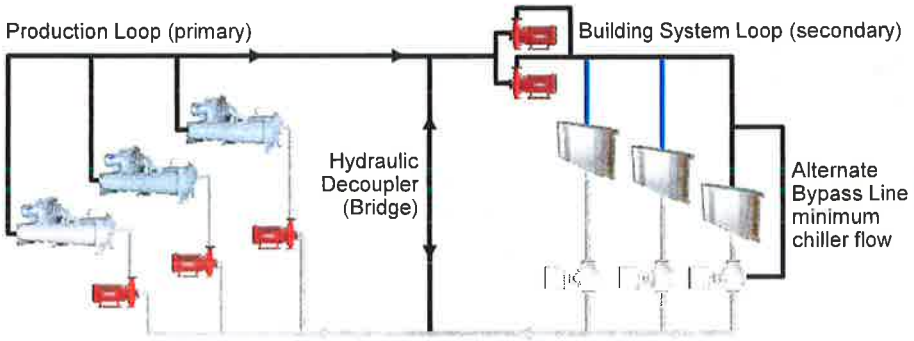
- Easy to provide pump standby (extra pump)
- Recommended for equal sized chillers
  - -- Each chiller starts stops its own pump
- Automatic isolation valves needed at chillers
- 3-way bypass valve needed



- Not recommended with unequal sized chillers

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Primary-Secondary System



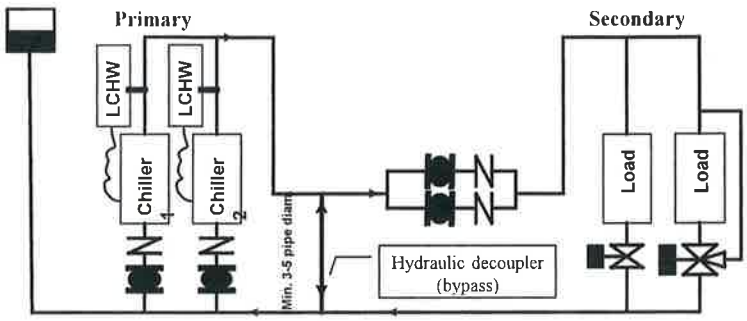
- Secondary pumping station
  - One pump active, the other standby (lead-lag)
  - Pumps are VFD-equipped if all coils are 2-way
  - Matches secondary flow to coil loads
- Hydraulic decoupler maintains constant primary flow

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Sizing the hydraulic decoupler

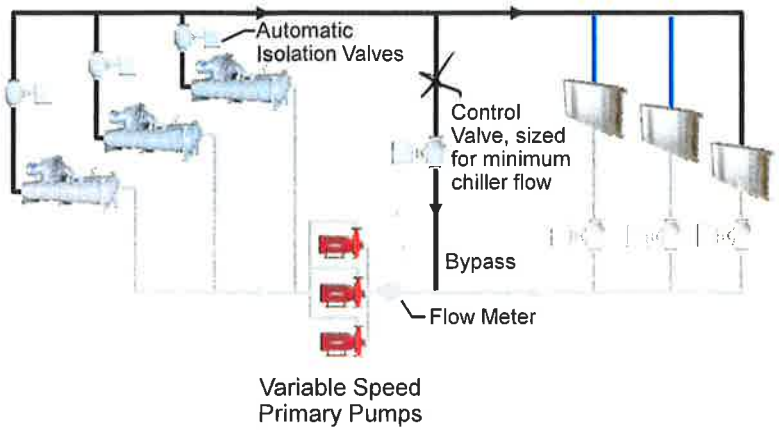
- Sizing is critical to ensure proper operation
- Max. ΔP in line should not exceed 1.5 ft.(4.5kPa) w.g.
- Line should be sized based on largest chiller pump flow and be a minimum of 3-5 pipe diameters long but for simplicity is often sized same size as main lines



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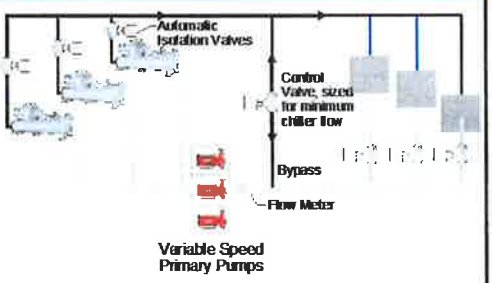
Primary-Only Variable-Flow



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Response to variable flow



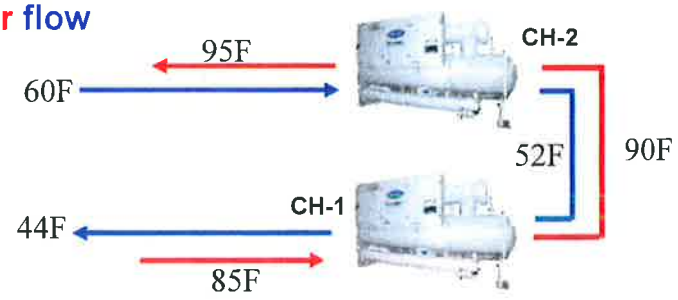


- Chiller heat exchanger water velocity range
  - [3(0.91m/s) < velocity < 12 (3.66m/s) feet per second]
- Typically sized for 8 to 10 fps
- Laminar flow & nuisance shut-downs below 3 fps
  - This represents (3/10) x 100 = 30% to (3/8) x100 = 38% flow
- Must keep flow to chiller above 40% typically

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Basic Series Counter Flow Diagram

Series Counter flow



Upstream chiller (CH-2) cools 60F – 52F

Downstream chiller (CH-1) cools 52F – 44F

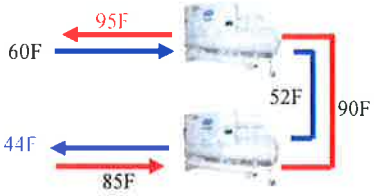
Evaporator water flows thru CH-2 and then CH-1

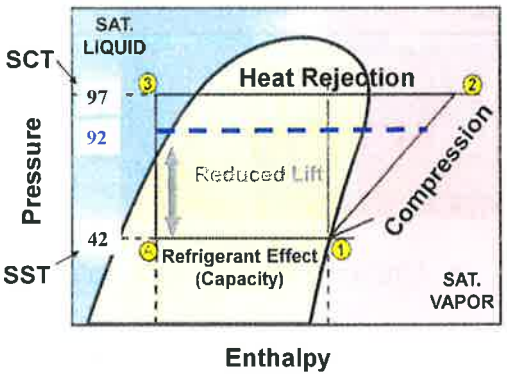
Condenser water flows thru CH-1 and then CH-2

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Series Counter flow Reduces Lift

Downstream Chiller





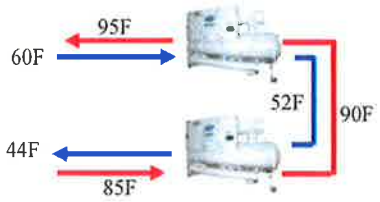
System	SST	SCT	Lift
Parallel	42	97	55
SCF	42	92	50

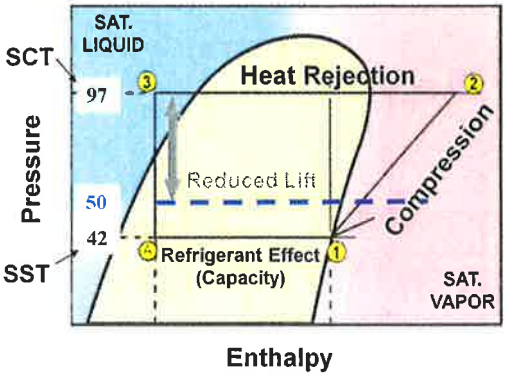
Lower Lift = Less Work = Lower kW

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Series Counter Flow Reduces Lift

Upstream Chiller





System	SST	SCT	Lift
Parallel	42	97	55
SCF	50	97	47

Lower Lift = Less Work = Lower kW

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Larger Delta T's Decreases Lift Further

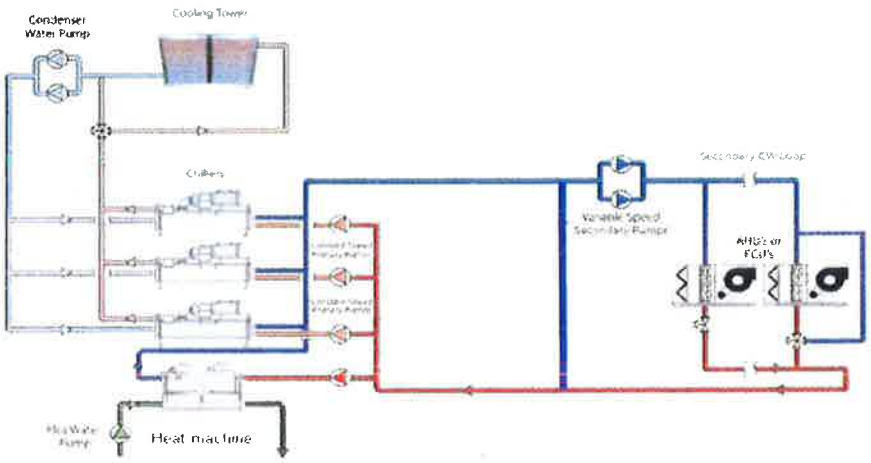
As Delta T goes up, the lift on the upstream machine decreases.

System Design	DS	US
44 -54	44	49
44 – 56	44	50
44 – 58	44	51
44 – 60	44	52

Series designs tend to have higher delta T's.

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PS System with Heat Machine



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