Achieving High Chilled Water Delta T in District Cooling Plants

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Outline

- ✓ Introduction
- ✓ Conventional Method
- ✓ Improved Method
- ✓ Case Studies
- ✓ Conclusions

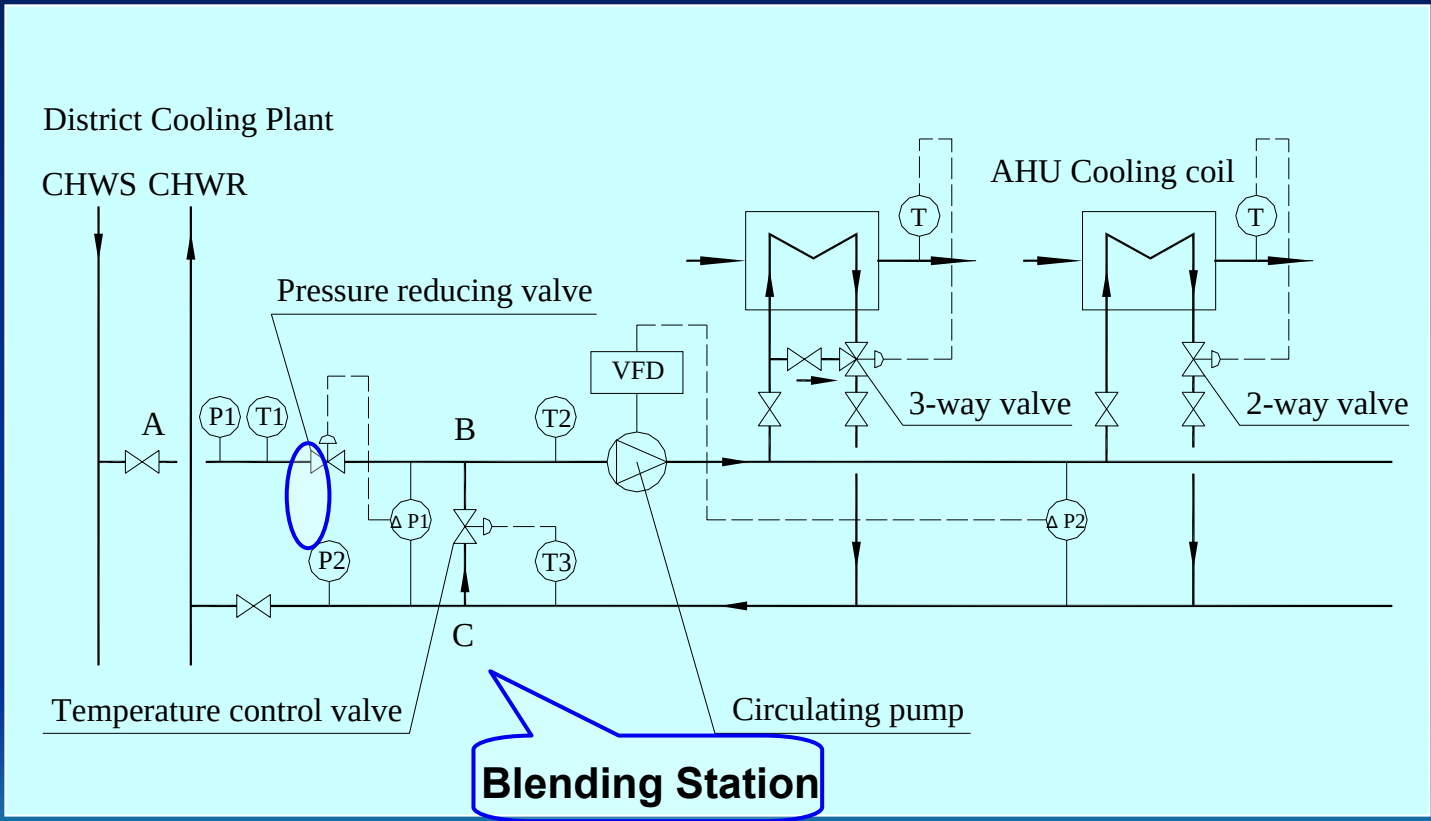
✓INTRODUCTION

Objectives of District Chilled Water Plant

- To ensure that every building in the district cooling system receive enough chilled water.
- To save pump power in both the central plant and buildings.
- To avoid chilled water penalty

✓**CONVENTIONAL METHOD**

Conventional Connections (systems)

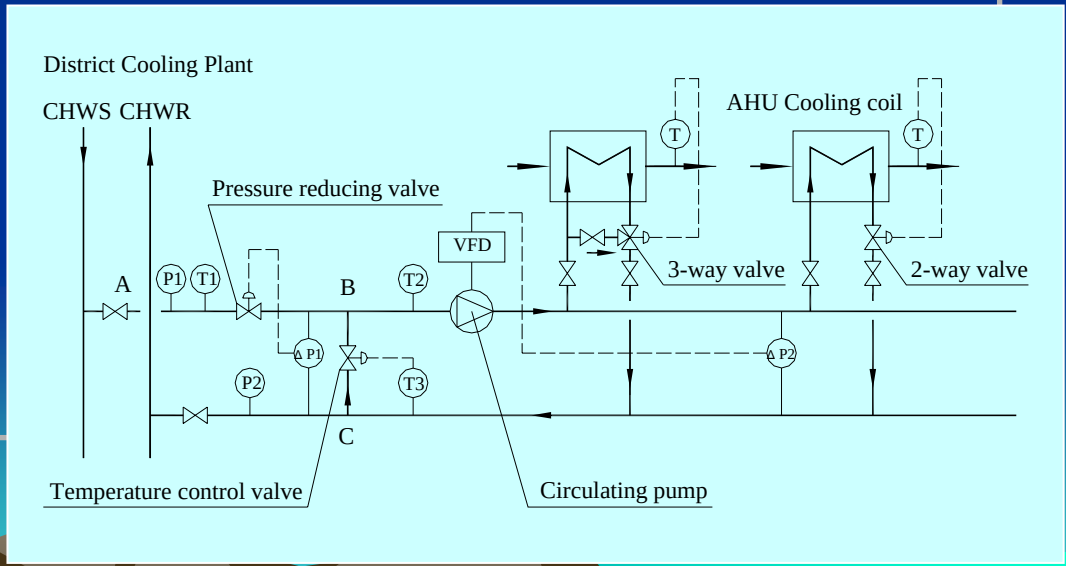


✓**CONVENTIONAL METHOD**

Basic Operation

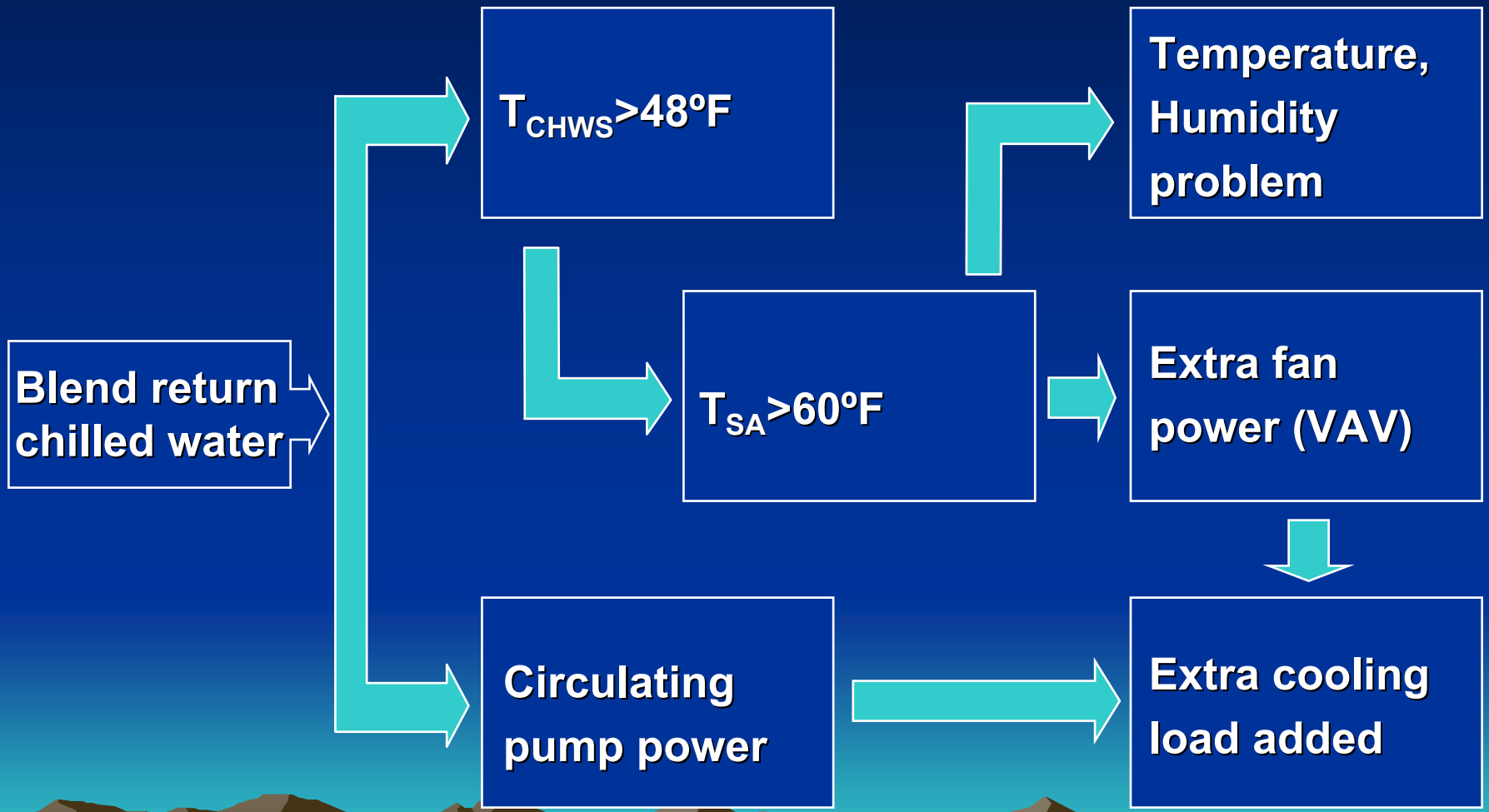
- **When T_{CHWS} is lower than the set point**

Blend return chilled water with primary supply chilled water from the central plant to *achieve high chilled water ΔT*.



✓CONVENTIONAL METHOD

Issues



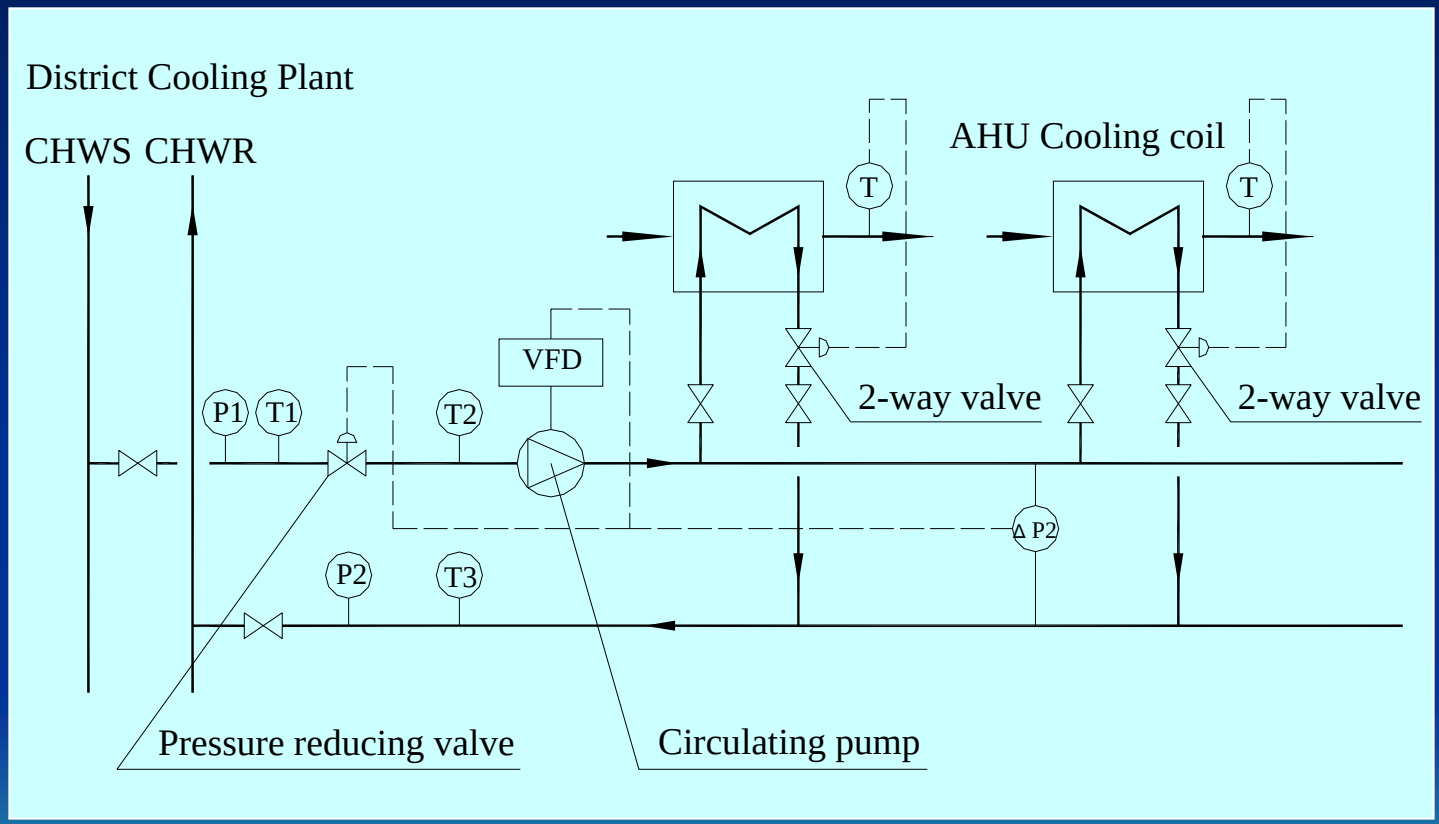
✓**IMPROVED METHOD**

Science and Good Practices

- **Science**
  - **Coils produce higher chilled water return temperatures (T_{CHWR}) at partial loads**
- **Good Practices**
  - **Convert 3-way control valves by 2-way**
  - **Keep coils clean**
  - **Balance the chilled water system**

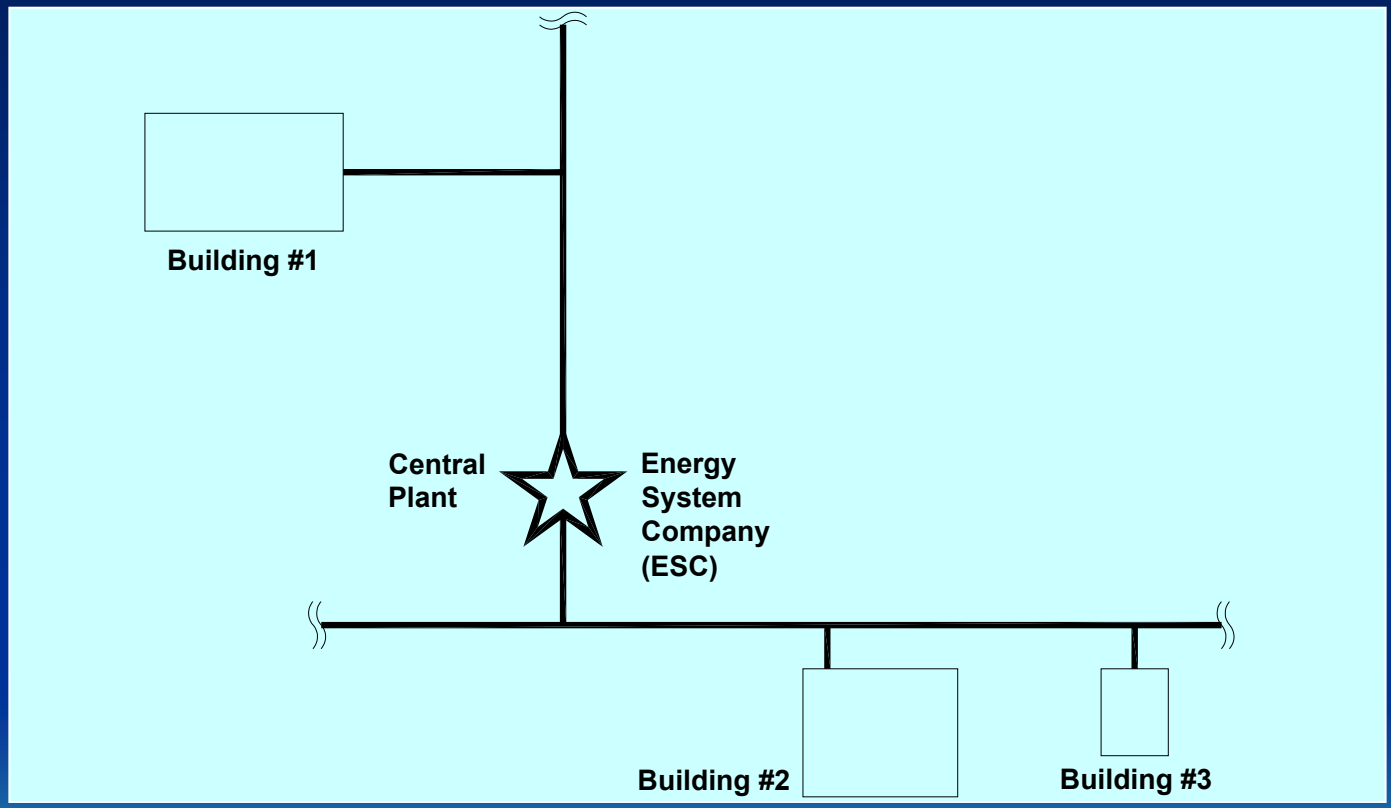
✓**IMPROVED METHOD**

Recommended Connection



✓**CASE STUDIES**

Three Case Studies

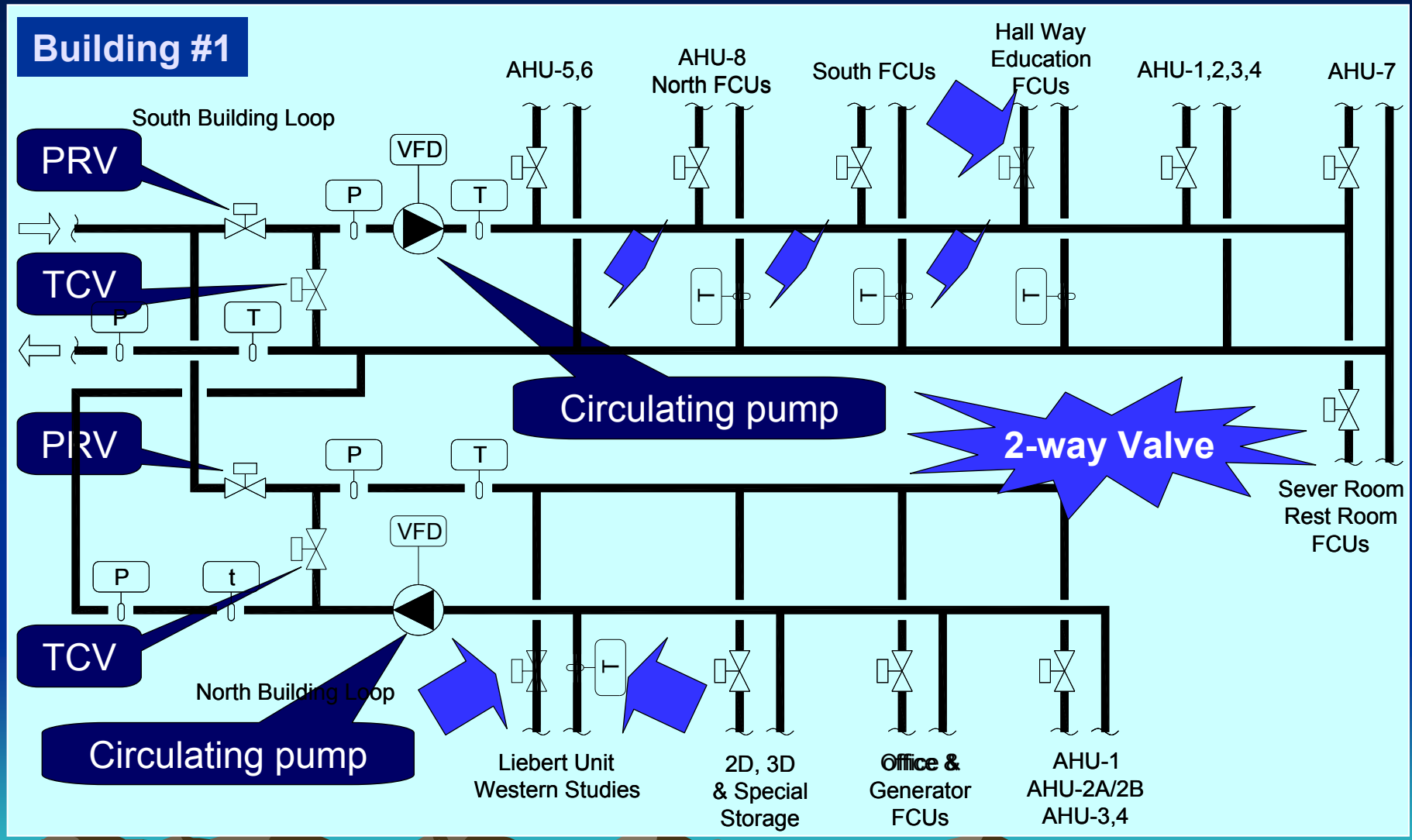


✓**CASE STUDIES**

System Information in Building #1

Type of building	Museum
Age of construction	1931/1994
Area (ft^2)	213,000
Operation schedule	24/7
CHW consumption in Aug. 2007 (ton·hrs)	99,230
Number of blending station	2
Circulating pump configuration for each station	1 with a VFD
Circulating pump power (HP)	20
Cooling coil valve configuration	2-way
CHWS, T2 range (ºF)	42~45
Humidity problem	No

✓CASE STUDIES



✓CASE STUDIES WITH RETROFITS

Basic Improved Operation in Building #1

Variable speed circulating pump

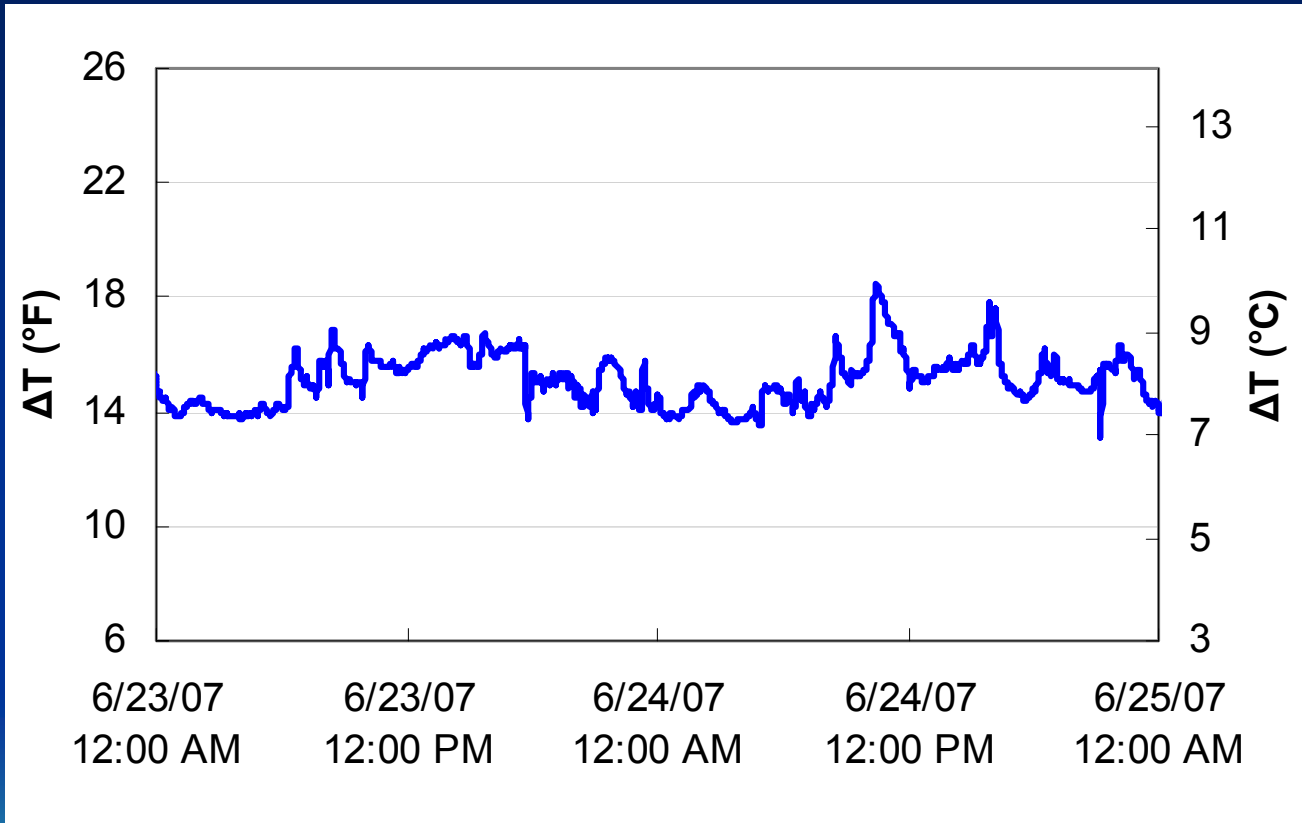
1.1 Disable circulating pump
1.2 Modulate PRV to maintain ΔP

If PRV is 100% open
& ΔP is less than the set point

2.1 Maintain PRV 100% open
2.2 Enable circulating pump and modulate it to maintain ΔP

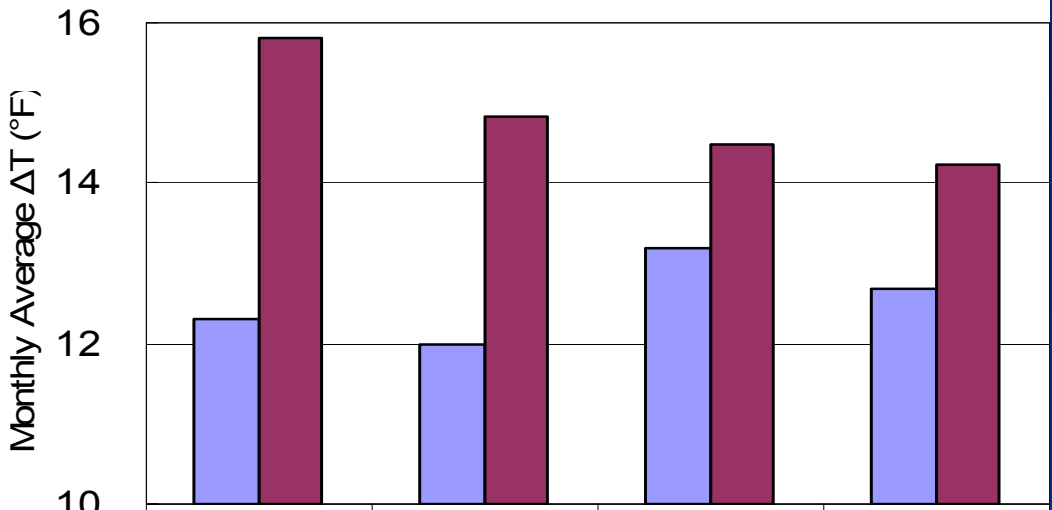
✓CASE STUDIES

Chilled Water ΔT in Building #1 after CC®



✓**RESULTS**

Comparison of ΔT in Building #1

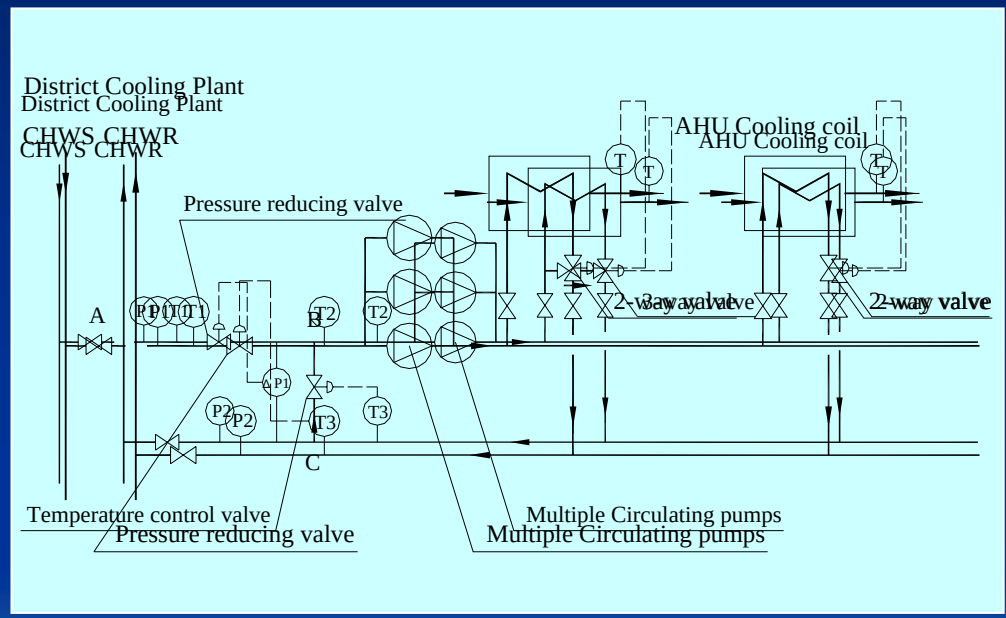


	May	June	July	August
2002~2006 average (Pre-CC®)	12.3	12.0	13.2	12.7
2007 (Post-CC®)	15.8	14.8	14.5	14.2

✓**CASE STUDIES**

Building #2 System Information

Type of building	Office
Age of construction	1970's
Area (ft^2)	230,000
Operation schedule	60hrs/week
CHW consumption (ton·hrs) Aug. 2007	193,000
Number of blending station	1
Circulating pump configuration	3 constant
circulating pump power (HP)	40 each
Cooling coil valve configuration	2-way & 3-way
CHWS, T2 range (ºF)	42~50
Humidity problem	Yes



✓CASE STUDIES WITH RETROFITS

Basic Improved Operation in Building #2

Constant speed circulating pump

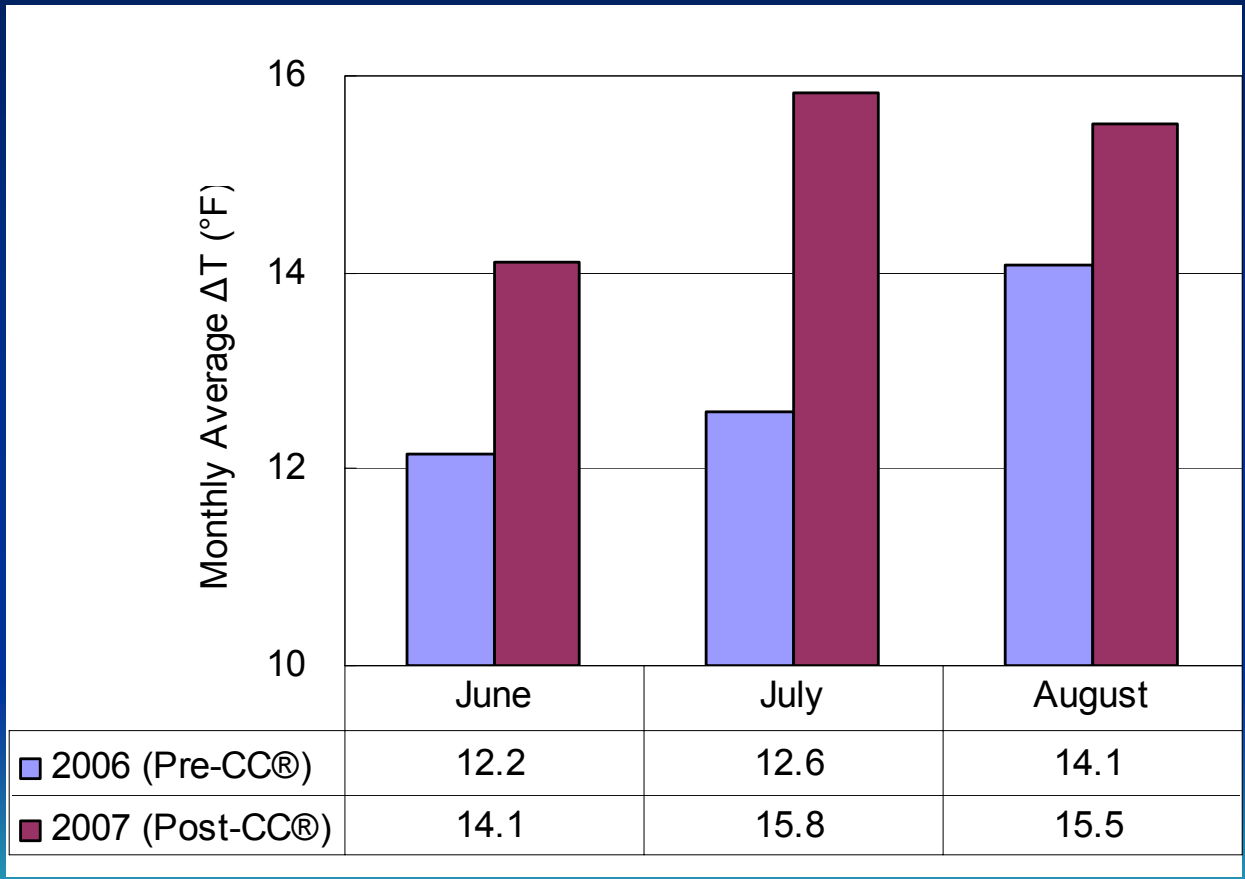
1.1 Disable circulating pump
1.2 PRV maintain T_{CHWR}

If PRV is 100% open
& T_{CHWR} is higher than the Stpt

2.1 Maintain PRV 100% open
2.2 Enable circulating pump(s) and modulate it to maintain T_{CHWR}

✓**RESULTS**

Comparison of ΔT in Building #2

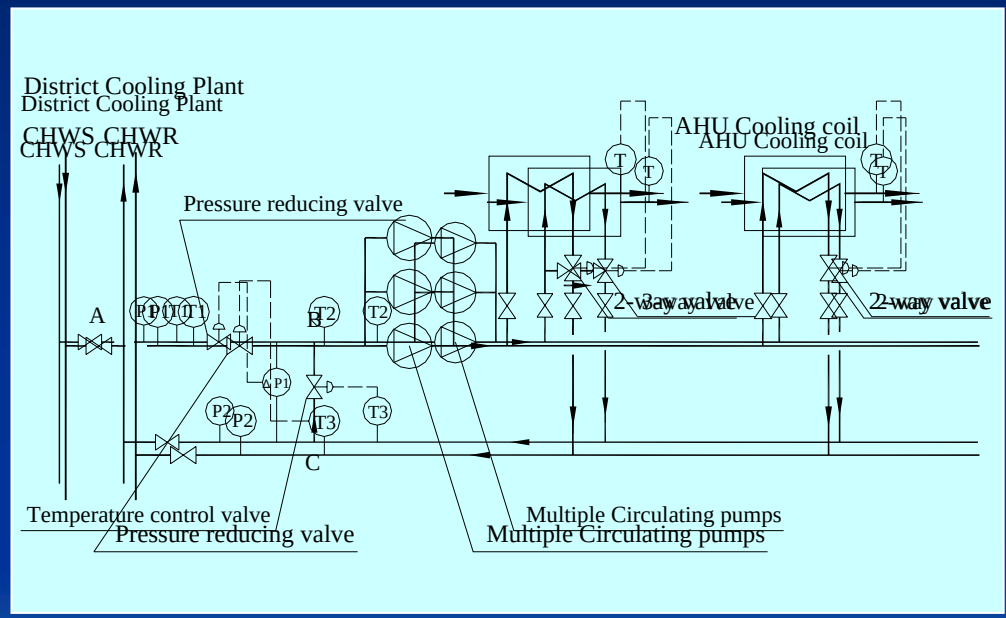


	June	July	August
2006 (Pre-CC®)	12.2	12.6	14.1
2007 (Post-CC®)	14.1	15.8	15.5

✓**CASE STUDIES**

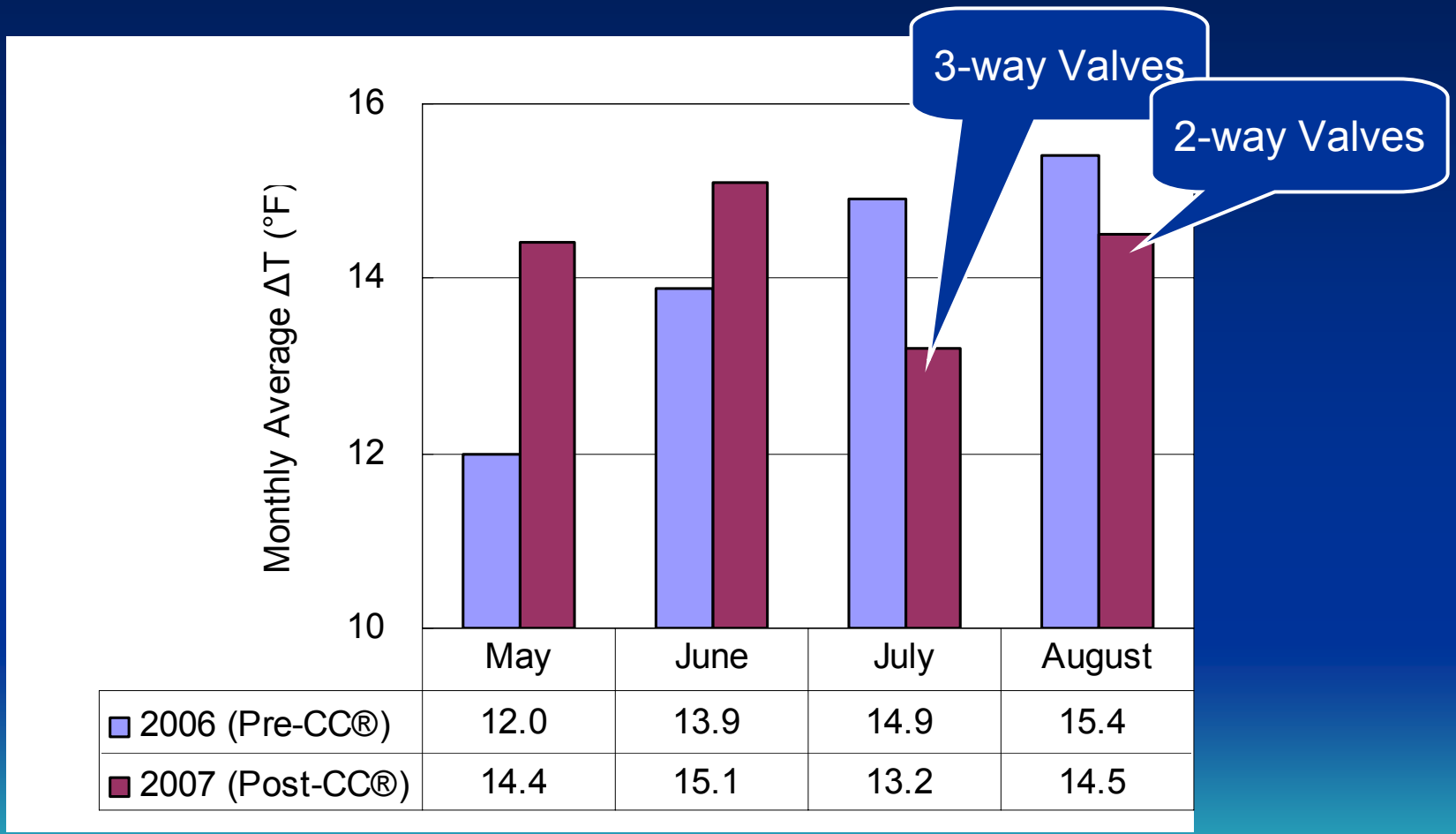
Building #3

Type of building	Office
Age of construction	1970's
Area (ft^2)	71,500
Operation schedule	70hrs/week
CHW consumption (ton·hr) Aug. 2007	36950
Number of blending station	1
Circulating pump configuration	3 constant
circulating pump power (HP)	10 each
Cooling coil valve configuration	2-way & 3-way
CHWS, T2 range (ºF)	42~50
Humidity problem	Yes



✓**RESULTS**

Comparison of ΔT in Building 3



	May	June	July	August
2006 (Pre-CC®)	12.0	13.9	14.9	15.4
2007 (Post-CC®)	14.4	15.1	13.2	14.5

Conclusions

- **Building blending station is not necessary to maintain the required T_{CHWR} or ΔT temperature.**
- **Without blending station, building pump power is eliminated.**
- **Without blending station, thermal comfort is improved by ensuring good control for space humidity and temperature.**


Questions?
Thank You!