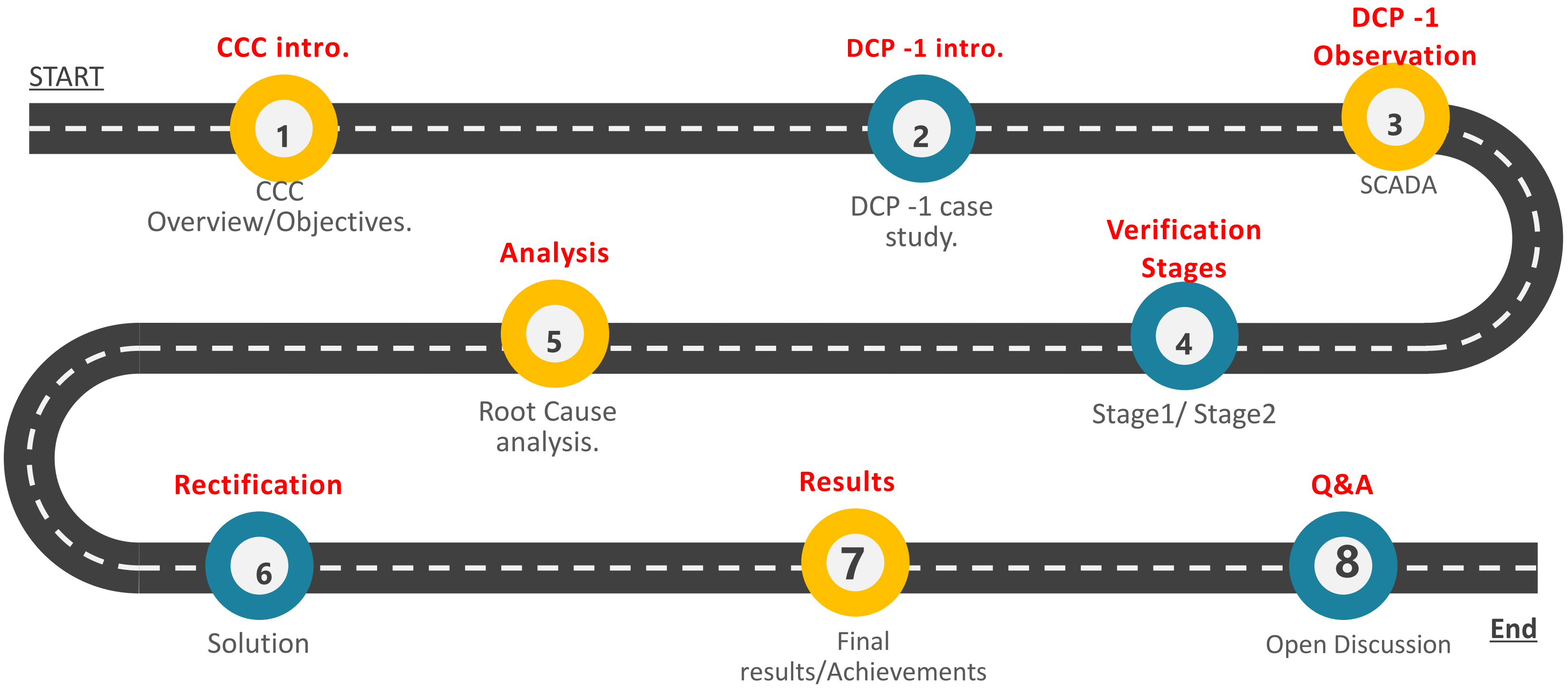
How Data Acquisition Helps To Enhance DCP Performance?

Thani AlMansoori - EMPOWER
Operations Supervisor - Command Control Center

Agenda


START
CCC intro.
1
CCC Overview/Objectives.
DCP -1 intro.
2
DCP -1 case study.
DCP -1 Observation
3
SCADA
Verification Stages
4
Stage1/ Stage2
Analysis
5
Root Cause analysis.
Rectification
6
Solution
Results
7
Final results/Achievements
Q&A
8
Open Discussion
End

Command Control Center (CCC)- Overview

Location
UAE

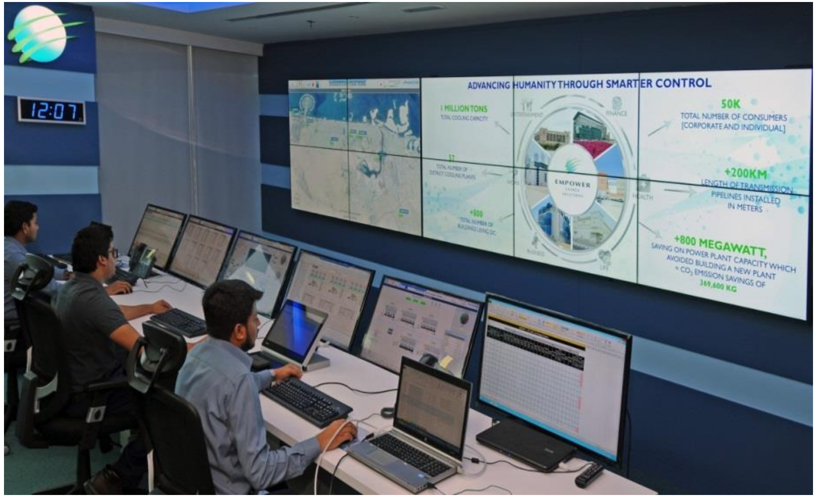
Established
2014, 24/7

DCP integrated
58 DCP

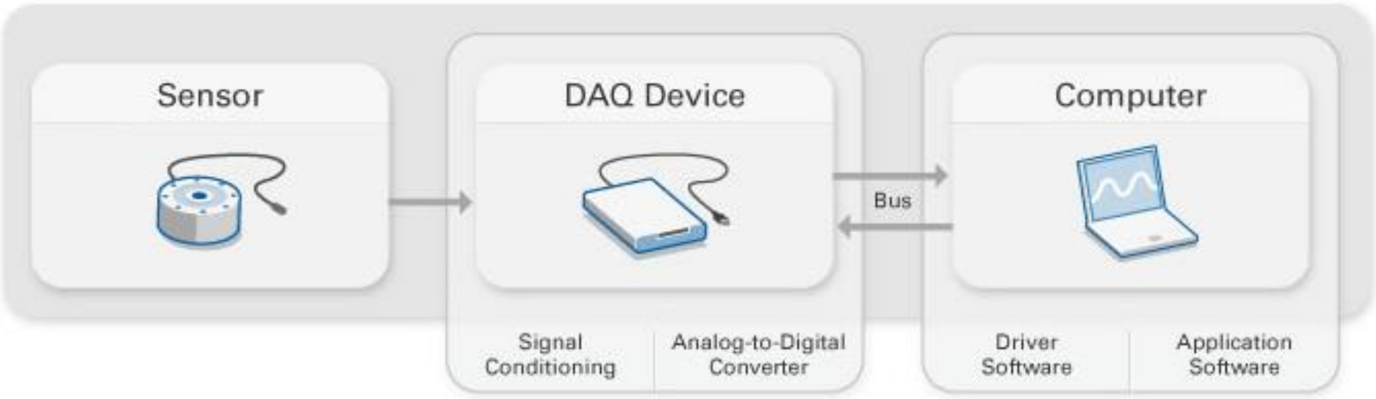
SETUP
Alarms/ Notifications

Command Control Center (CCC)- Objectives

1) Remote operation of the DC plants.
2) Standardization of DC plant operation
3) Centralized data acquisition and archiving.
4) Regular analysis of Operation data logs.
5) Acknowledging the alarms and notifying to the concern team for rectification.
6) DC plant load forecast based on historical data.
7) Assist Management for decision making.



Data acquisition Intro.



<u>Data acquisition (DAQ)</u> is the process of measuring an Thermal or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer. A DAQ system consists of sensors, DAQ measurement hardware, and a computer with programmable software.

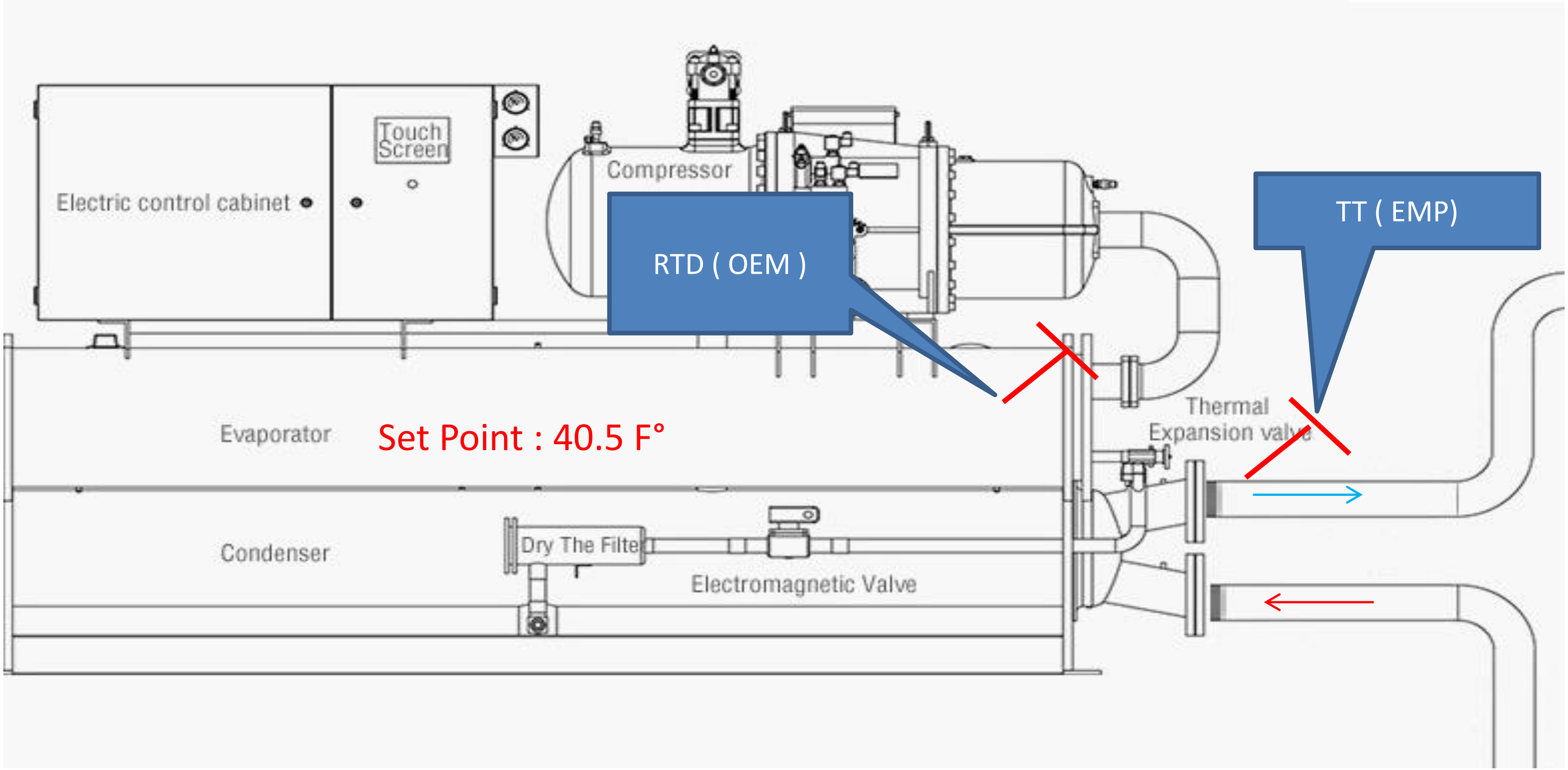
Case Study – DCP-1

- ✓ This case study explains the "Operational Improvement" achieved by using the acquired data and sensible analysis.
- ✓ This study and improvement achieved **without any additional financial investment.**

Plant Overview:

Maximum Plant capacity (TR)	: 56,000
Installed Capacity (TR)	: 24,840 *
No of chiller (TR)	: 12 x 2,070
Plant in operation Since	: Y2006
Chiller Type	:Centrifugal CH comp.

Case Study – DCP-1



Case Study – DCP-1

"Chiller Module 17"
CHILLER VALUES

DESCRIPTION	CIRCUIT A	CIRCUIT B	UNITS
CDW Entering Temp	77.5	77.5	°F
CDW Leaving Temp	85.4	85.4	°F
CHW Entering Temp	48.7	48.7	°F
CHW Leaving Temp Chiller RTD	40.5	40.5	°F
Cond Sat Refrig Press	16.4	17.6	PSI
Cond Sat Refrig Temp	84.4	90.3	°F
Evap Sat Refrig Press	4.9	5.1	PSI
Evap Sat Refrig Temp	34.3	35.5	°F
Oil Temp	114.8	113.2	°F
Comp Starts	432	438	
COMPRESSOR %RLA	77.1	83.1	%
Current Limit SP	100.0	100.0	%
CHW SP Set Point	40.5	40.5	°F
COMPRESSOR Run Hrs	21202	21228	
COMPRESSOR KW	556	611	KW
Chiller Tonnage	1649		TR
Entering Chilled Water Temp	48.56		°F
Leaving Chilled Water Temp Header TT	36.50		°F
Condensor Entering Water Temp	77.00		°F
Condensor Leaving Water Temp	85.64		°F

"Chiller Module 25"
CHILLER VALUES

DESCRIPTION	CIRCUIT A	CIRCUIT B	UNITS
CDW Entering Temp	77.6	77.6	°F
CDW Leaving Temp	85.2	85.2	°F
CHW Entering Temp	49.4	49.4	°F
CHW Leaving Temp Chiller RTD	40.5	40.5	°F
Cond Sat Refrig Press	15.5	16.9	PSI
Cond Sat Refrig Temp	85.0	89.0	°F
Evap Sat Refrig Press	5.6	5.9	PSI
Evap Sat Refrig Temp	38.9	41.2	°F
Oil Temp	117.6	120.2	°F
Comp Starts	484	474	
COMPRESSOR %RLA	73.2	74.5	%
Current Limit SP	100.0	100.0	%
CHW SP Set Point	40.5	40.5	°F
COMPRESSOR Run Hrs	20379	20360	
COMPRESSOR KW	667	553	KW
Chiller Tonnage	1555		TR
Entering Chilled Water Temp	49.10		°F
Leaving Chilled Water Temp Header TT	38.48		°F
Condensor Entering Water Temp	77.36		°F
Condensor Leaving Water Temp	85.28		°F

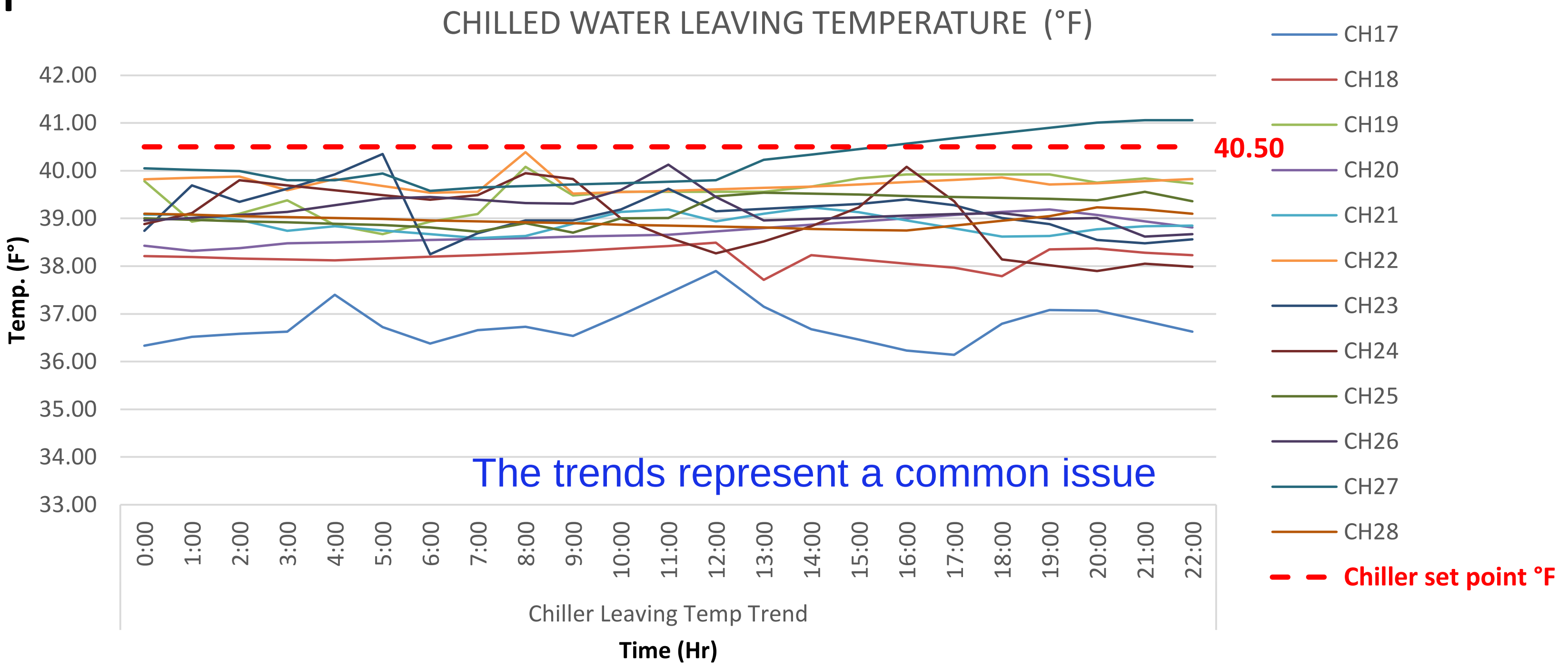
"Chiller Module 28"
CHILLER VALUES

DESCRIPTION	CIRCUIT A	CIRCUIT B	UNITS
CDW Entering Temp	76.3	76.3	°F
CDW Leaving Temp	83.4	83.4	°F
CHW Entering Temp	49.0	49.0	°F
CHW Leaving Temp Chiller RTD	40.3	40.3	°F
Cond Sat Refrig Press	15.3	17.2	PSI
Cond Sat Refrig Temp	83.9	88.0	°F
Evap Sat Refrig Press	5.5	5.9	PSI
Evap Sat Refrig Temp	38.7	41.5	°F
Oil Temp	110.6	111.5	°F
Comp Starts	392	390	
COMPRESSOR %RLA	74.0	70.9	%
Current Limit SP	100.0	100.0	%
CHW SP Set point	40.5	40.5	°F
COMPRESSOR Run Hrs	18386	18413	
COMPRESSOR KW	526	518	KW
Chiller Tonnage	1553		TR
Entering Chilled Water Temp	49.12		°F
Leaving Chilled Water Temp Header TT	38.38		°F
Condensor Entering Water Temp	76.40		°F
Condensor Leaving Water Temp	83.78		°F

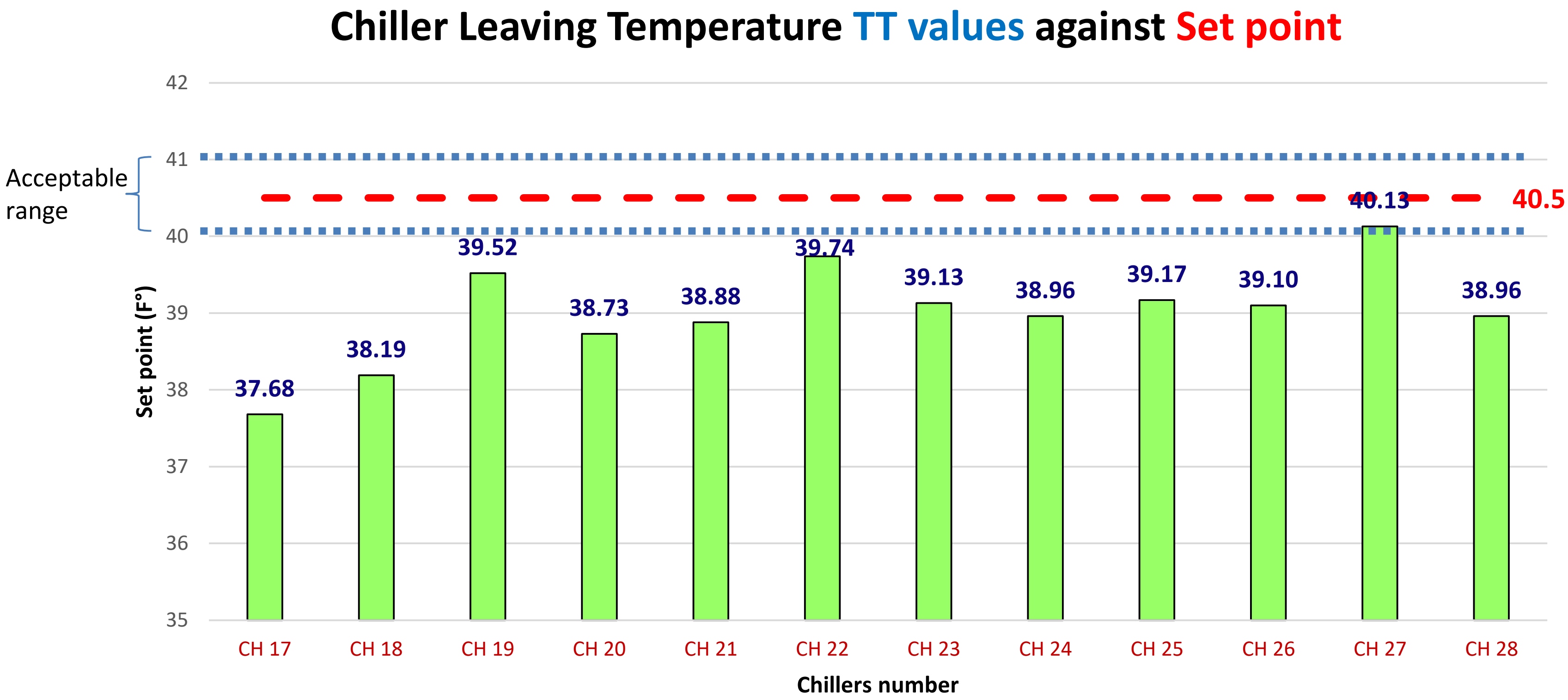
Its noted, 9 nos (out of 12 nos) of the chillers having such CHW temperature differences

Case Study – DCP-1 Findings

Finding: Observed the Chiller Leaving Temperature TT value lower than the Chiller SET POINT



Case Study – DCP-1



STAGE 1

Verification Stages

The Temperature Sensor Verification

Set Point Temp. in Micro bath (°F)	Chiller Leaving Temp. (°F)	PLC & SCADA leaving Temp. Transmitter (°F)
32	32.3	32
41	41.2	41
50	50.2	49.8
59	59.3	58.8
68	68.2	67.8

- ✓ Chiller RTD found okay
- ✓ Header TT also found Okay.
- ✓ The differences are within acceptable limit.

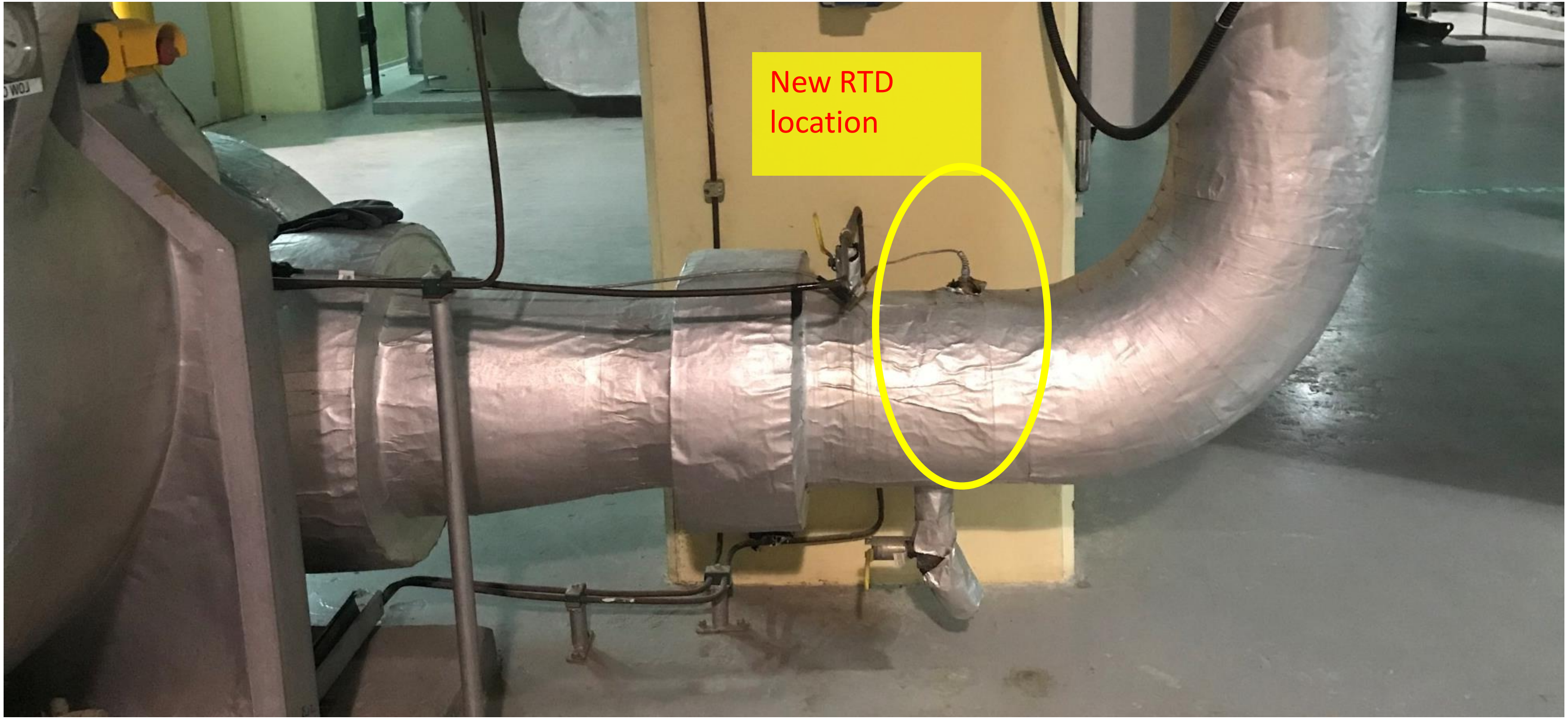
Case Study – DCP-1

<u>Filed investigation</u>

Suggested to shift the Chiller RTD location at a well mixed area (turbulent section, near elbow).

Subsequently shifted one of the Chiller RTD and observed the changes. It shows good improvement.

Case Study – DCP-1



Case Study – DCP-1

Root Cause Analysis

CH 25"

"Chiller Module 25"
CHILLER VALUES

DESCRIPTION	CIRCUIT A	CIRCUIT B	UNITS
CDW Entering Temp	77.6	77.6	°F
CDW Leaving Temp	85.2	85.2	°F
CHW Entering Temp	49.4	49.4	°F
CHW Leaving Temp **Chiller RTD**	40.5	40.5	°F
Cond Sat Refrig Press	15.5	16.9	PSI
Cond Sat Refrig Temp	85.0	89.0	°F
Evap Sat Refrig Press	5.6	5.9	PSI
Evap Sat Refrig Temp	38.9	41.2	°F
Oil Temp	117.6	120.2	°F
Comp Starts	484	474	
COMPRESSOR %RLA	73.2	74.5	%
Current Limit SP	100.0	100.0	%
CHW SP **Set Point**	40.5	40.5	°F
COMPRESSOR Run Hrs	20379	20360	
COMPRESSOR KW	667	553	KW
Chiller Tonnage	1555		TR
Entering Chilled Water Temp	49.10		°F
Leaving Chilled Water Temp **Header TT**	38.48		°F
Condensor Entering Water Temp	77.36		°F
Condensor Leaving Water Temp	85.28		°F

Cause:

- The Chiller RTD reads incorrect value (reads high) as the RTD location is inappropriate.
- The chiller Compressors loading based on RTD
- The error RTD reads force the compressor to run excessively and consume more electrical energy.
- As such CHW temperature reach lower than set point.
- This affected the plant efficiency significantly.

Case Study – DCP-1

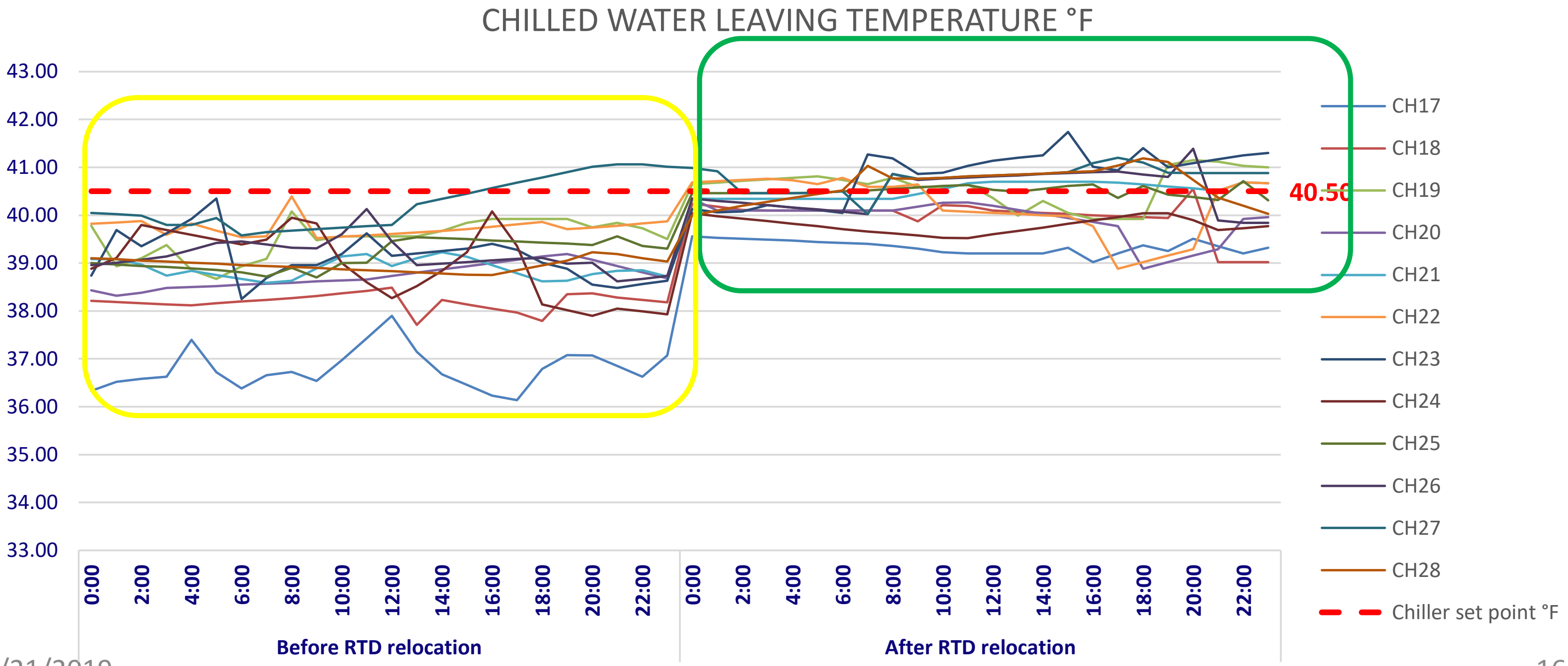
Rectification stage- comparison & results

- ✓ The Chiller RTD shifted near the elbow pipe line, where the CHW mixing well and results appropriate reads to the Compressor control panel.
- ✓ This solution reduce the compressor lift and save electrical input energy to the compressor of each chiller.

Chiller Tag	CH Leaving CHW Set Point °F	Chiller Leaving Temp TT read (Avg) °F [Before TT Relocation]	Chiller Leaving Temp TT read (Avg) °F [after RTD relocation]	Deviation from Setpoint (Before RTD Relocation)	Deviation from Setpoint (After RTD Relocation)
CH 17	40.5	37.68	39.94	2.82	0.56
CH 18	40.5	38.19	39.96	2.31	0.54
CH 19	40.5	39.52	40.59	0.98	-0.09
CH 20	40.5	38.73	39.92	1.77	0.58
CH 21	40.5	38.88	40.52	1.62	-0.02
CH 22	40.5	39.74	40.43	0.76	0.07
CH 23	40.5	39.13	40.66	1.37	-0.16
CH 24	40.5	38.96	39.89	1.54	0.61
CH 25	40.5	39.17	40.50	1.33	0
CH 26	40.5	39.10	40.52	1.4	-0.02
CH 27	40.5	40.13	40.63	0.37	-0.13
CH 28	40.5	38.96	40.38	1.54	0.12

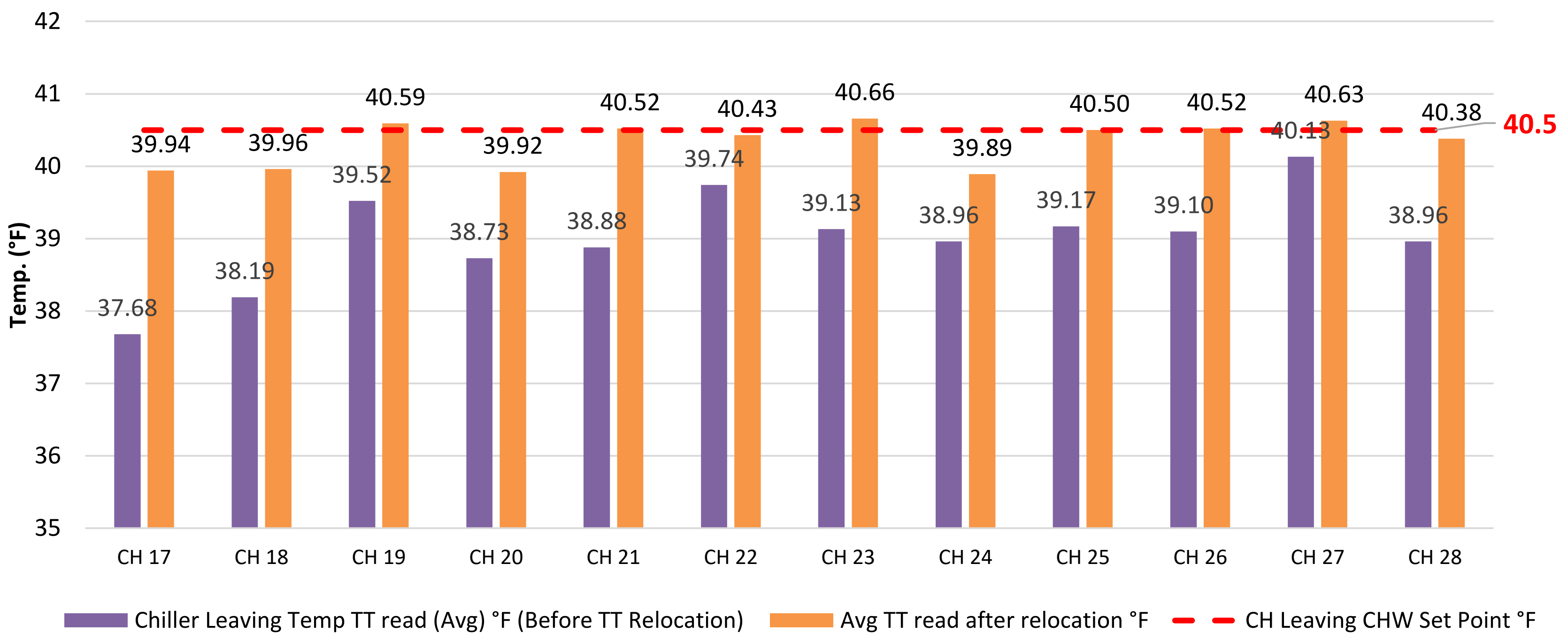
Case Study – DCP-1

Chilled Water Leaving Temperature Trend – Before and after RTD relocation



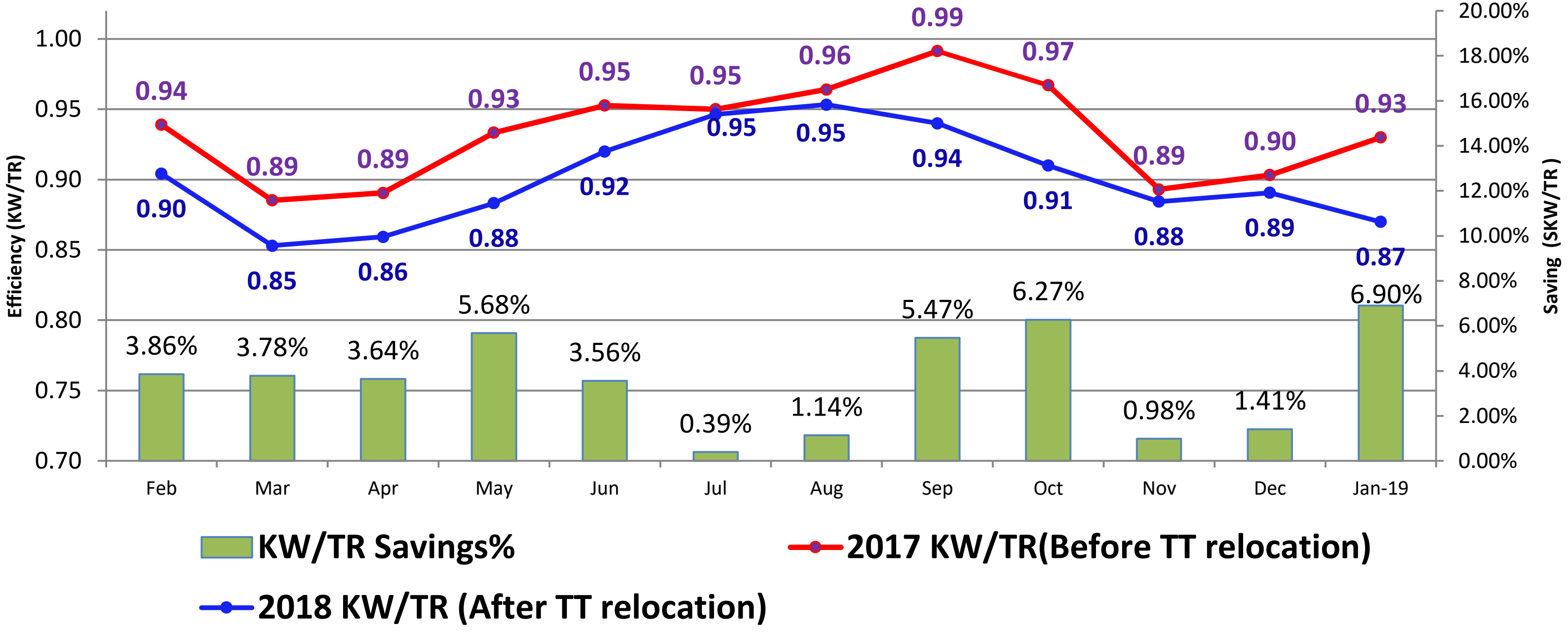
Case Study – DCP-1

After the relocation of Chiller RTD of each chiller, the Chilled water leaving temperatures are close to the Set Point.



Saving?

The DCP-1 plant performance improvement assessed continuously, the results are plotted in the below graph



Case Study – DCP-1

The DCP-1 plant performance improvement – Net KWH Savings

DCP-1	2017 KW/TR(Before TT relocation)	2018 KW/TR (After TT relocation)	KW/TR Savings%	KWH Saving
Feb	0.94	0.90	3.86%	76,876
Mar	0.89	0.85	3.78%	101,914
Apr	0.89	0.86	3.64%	135,070
May	0.93	0.88	5.68%	278,769
Jun	0.95	0.92	3.56%	214,107
Jul	0.95	0.95	0.39%	28,444
Aug	0.96	0.95	1.14%	87,760
Sep	0.99	0.94	5.47%	345,551
Oct	0.97	0.91	6.27%	338,404
Nov	0.89	0.88	0.98%	34,702
Dec	0.90	0.89	1.41%	37,332
Jan-19	0.93	0.87	6.90%	151,161
6/21/2019		Total KWH Savings		1,830,090

Case Study – DCP-1 Saving

This findings and improvement are saved 1,830 MWH electrical energy up to Jan 2019.

This is equivalent to AED 814,390 (US$ 215,447)

275 Passenger vehicles driven for one year

155 homes' energy use for one year

21,399 tree seedlings grown for 10 years

ISO 14001 BUREAU VERITAS Certification

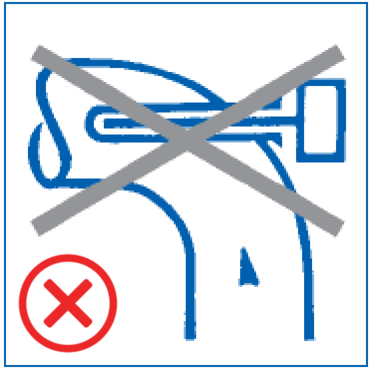
As United States Environmental Protection Agency Standers (EPA)

Recommendations?

Recommendations?

Install sensors against flow direction

Install Sensors At the correct angle.



Incorrect installation- Avoid

Summary

PROBLEM	ACTIVITY	SOLUTION	IMPACT
Chiller not achieving chiller leaving set point.	Micro – Bath testing carried out.	Re-locate RTD near to a well mix area	• Electrical Saving • Money Saving • CO_2 and GHG reduction

THANK YOU