Retro-commissioning (RCx)

Example 14 - Adjust Equipment Operation Hour

- ESO: Optimize operational hour of plant and equipment with timer control.

Office Hour

After Work

EMSD

Retro-commissioning (RCx)

Example 14 - Adjust Equipment Operation Hour

- ESO: Optimize operational hour of plant and equipment with timer control.

- Use power meter / amp meter with logger to measure the daily operation of facility or equipment continuous for a period
- Measurement period cover working day, weekly holiday and public holiday
- Check the measurement result against the working hour

EMSD

Example 14 - Adjust Equipment Operation Hour

Case Study

Saving Estimation

Saving = Equipment power rating x saved operation hour

An 5-days working office with AHU, which is schedule to operate from 8:00 to 19:00. The AHU fan power is 15kW. It was found that the timer is malfunction and the fan is operation 24 hours non-stop.

Example 14 - Adjust Equipment Operation Hour

Case Study

Saved Operation hour on working day
= 24 – 11 = 13 hours

Total saved operation hour per year
= 13 x 5 x 52 + 24 x 2 x 52 = 5,876 hours

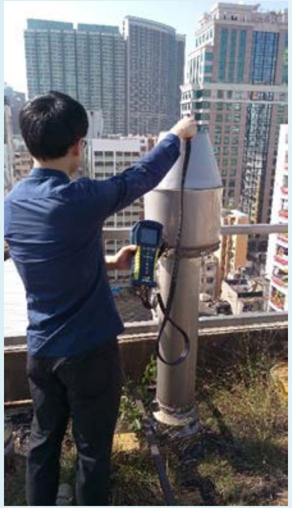
Saving = 15 x 5,876 = 88,140 kWh

Retro-commissioning (RCx)

Example 15 - Improve Gas Boiler Combustion Efficiency

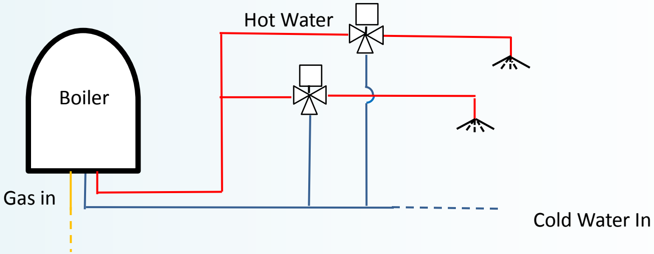
➢ ESO: Adjust Gas / air ratio in order to achieve optimal combustion efficiency.

Facility/ Equipment



Recommendation

- Adjust gas / air ratio in order to achieve optimal combustion

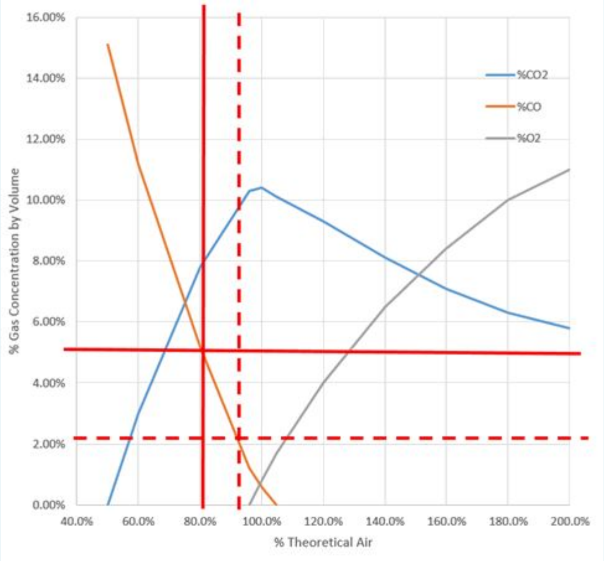


Retro-commissioning (RCx)

Example 15 - Improve Gas Boiler Combustion Efficiency

➢ ESO: Adjust gas / air ratio in order to achieve better combustion efficiency.

Facility/ Equipment



Observation

- Measure CO content of flue gas at boiler exhaust and trace amount of CO
- high CO content in the flue gas
- incomplete combustion occurred
- Boiler Combustion efficiency affected

EMSD

Example 15 - Improve Gas Boiler Combustion Efficiency

- ESO: Adjust gas / air ratio in order to achieve better combustion efficiency.

% of CO $_{\text{(Produced from combustion)}}$
= (Measured CO $_{\text{in ppm}}$ / CO density $_{\text{in kg/m3}}$) /1000 - % of CO $_{\text{(from Gas)}}$

% excess fuel gas $_{\text{in combustion}}$
= % of CO $_{\text{(Produced from combustion)}}$

Annual Fuel gas saving
= (Annual consumption of fuel gas) x (% excess fuel gas $_{\text{in combustion}}$)

Retro-commissioning (RCx)

Example 15 - Improve Gas Boiler Combustion Efficiency

Case Study

The Boiler's annual gas consumption is about 18,195 unit and spending about $221,311 for the bill per annual.

According to the site measurement, the measured concentration of CO is 78 ppm.

% of CO (Produced from combustion) = (78 / 1.4[#]) /1000 – 2.1%[@]
= 5.3% – 2.1%
= 3.2%

% excess fuel gas in combustion = 3.2%

EMSD

Example 15 - Improve Gas Boiler Combustion Efficiency

Case Study

Remark:-

@In the study, the concentration of CO in fuel gas is ranged from 1% to 3.1%. The average value of CO concentration is 2.1%.

#CO density $_{\text{in kg/m3}}$ = 1.14kg/m^3

EMSD

Retro-commissioning (RCx)

Example 15 - Improve Gas Boiler Combustion Efficiency

Case Study

Annual Fuel gas saving = (Annual gas consumption) x (% excess fuel gas $_{\text{in combustion}}$)

Annual Fuel gas saving = 18,195 x 3.2%
= 582 unit
= 27,936MJ*1
~ $ 7,000

Remark:-

*1 *Each unit of fuel gas represents a heat value of 48MJ*

EMSD

Retro-commissioning (RCx)

Example 16 – Lightings Optimization

ESO: To adopt the use of daylighting (by computer simulation)

Facility / Equipment

Observation

- No daylighting sensors are installed in the building except for the main entrance lobby. As a consequence, lighting fixtures keep on operating even when a space is well illuminated due to transmission of visible light during daytime.

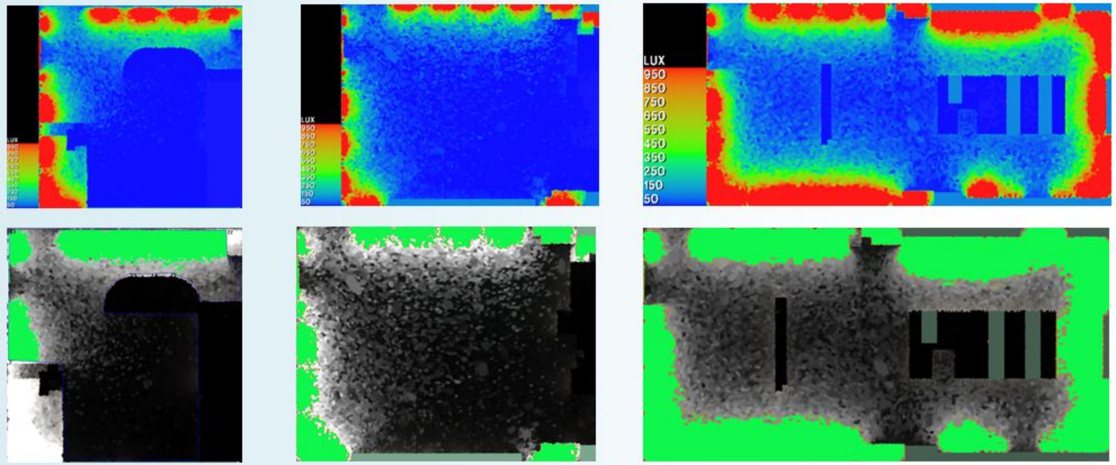
EMSD

Retro-commissioning (RCx)

Example 16 – Lightings Optimization

ESO: To adopt the use of daylighting (by computer simulation)

1F carpark daylight distribution | 2F carpark daylight distribution | 5F carpark daylight distribution



19% area exceed 300lux | 10% area exceed 300lux | 36% area exceed 300lux

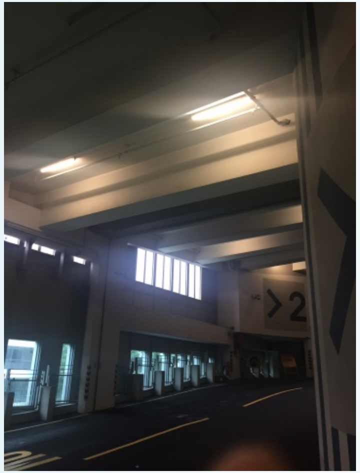
Space Type	Typical illuminance level (lux)
Parking	50**

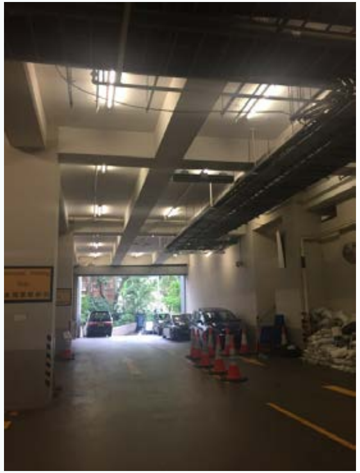
EMSD

Retro-commissioning (RCx)

Example 16 – Lightings Optimization

ESO: To adopt the use of daylighting (by computer simulation)





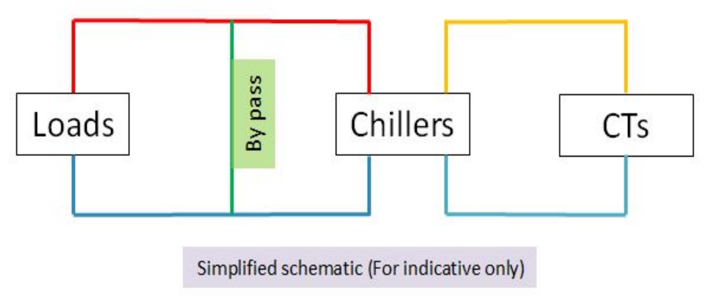
EMSD

Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)

Facility / Equipment



Observation

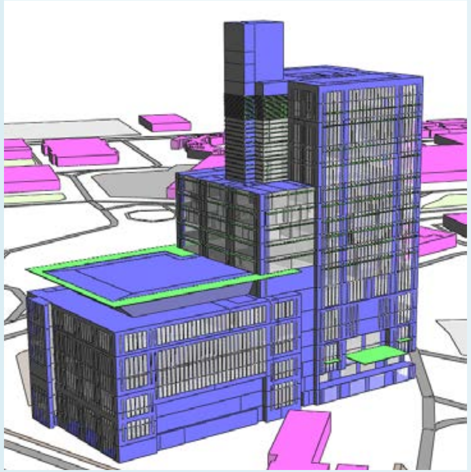
- 2 heat recovery VSD centrifugal chillers and 2 VSD centrifugal chillers all with ~1900kW
- 1 small screw chiller (~800kW) and 1 small air cooled chiller (~500kW)
- Operation control of the chillers is based on the building load demand (ranged from 300kW to 3500kW) and the operating hours of the chillers
- Consist

Retro-commissioning (RCx)

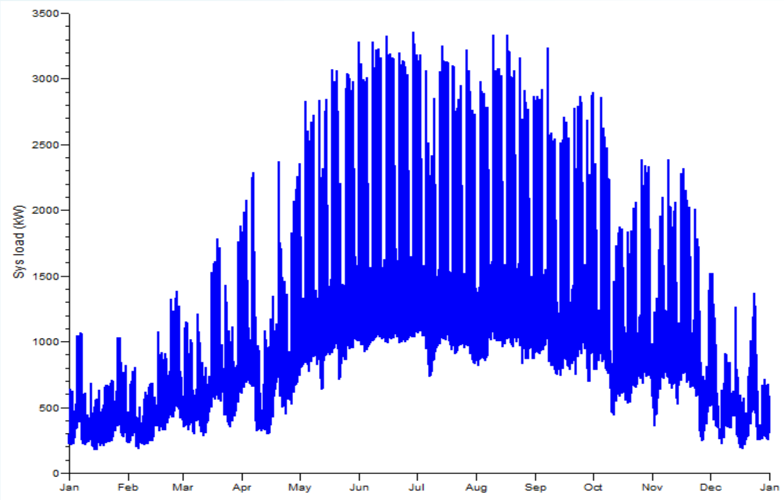
Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)

Facility / Equipment



Observation



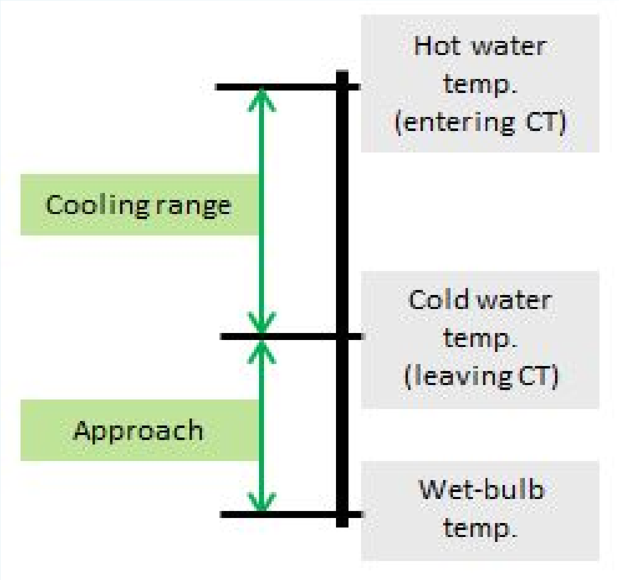
EMSD

Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)

Facility / Equipment



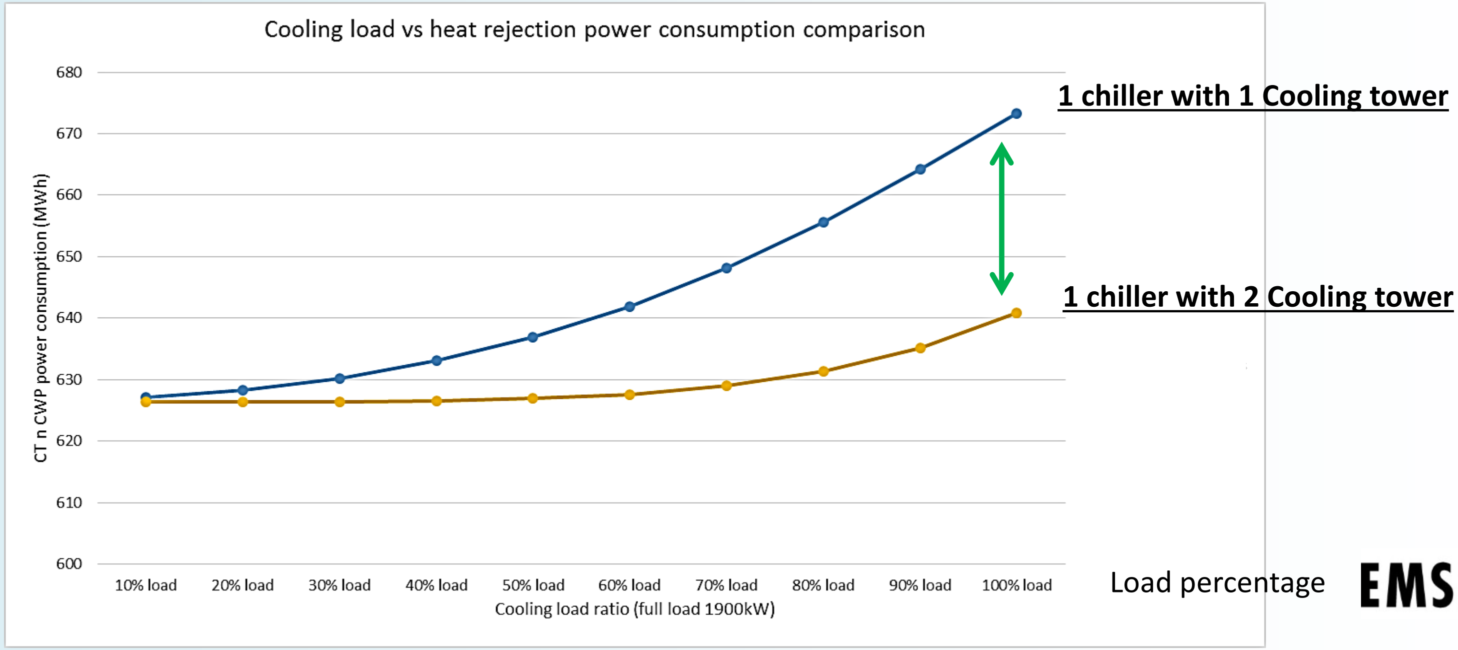
EMSD

Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)

Cooling Tower Fan + Condensate water pump Power consumption



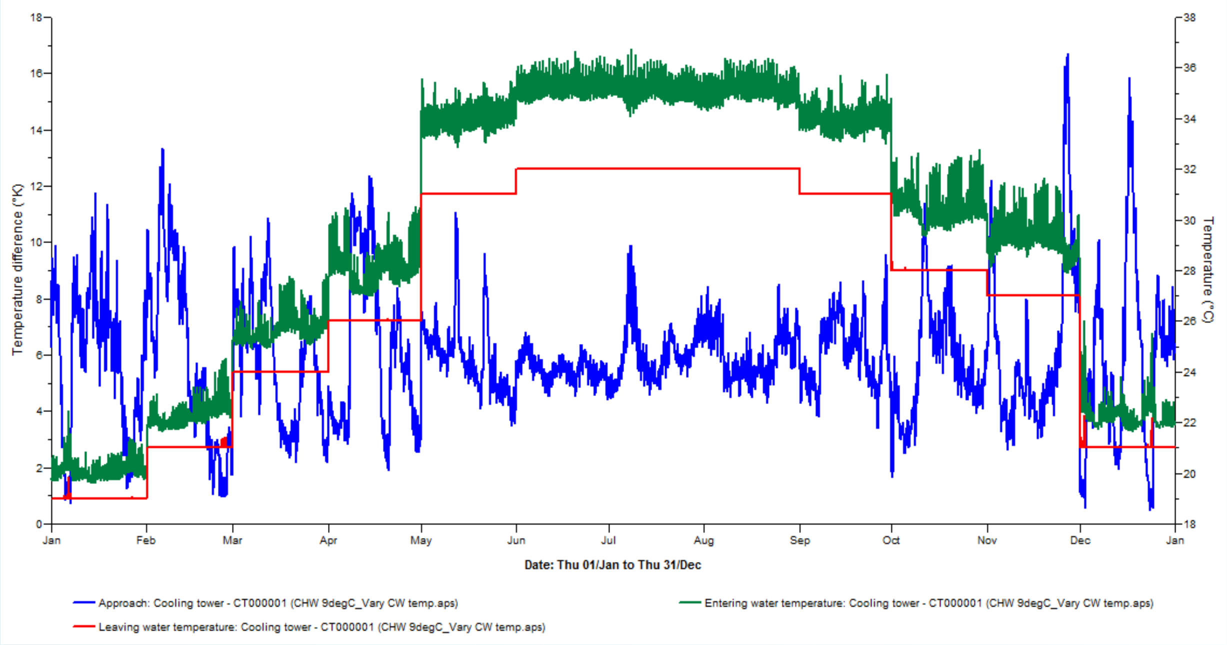
Load percentage

EMSD

Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)



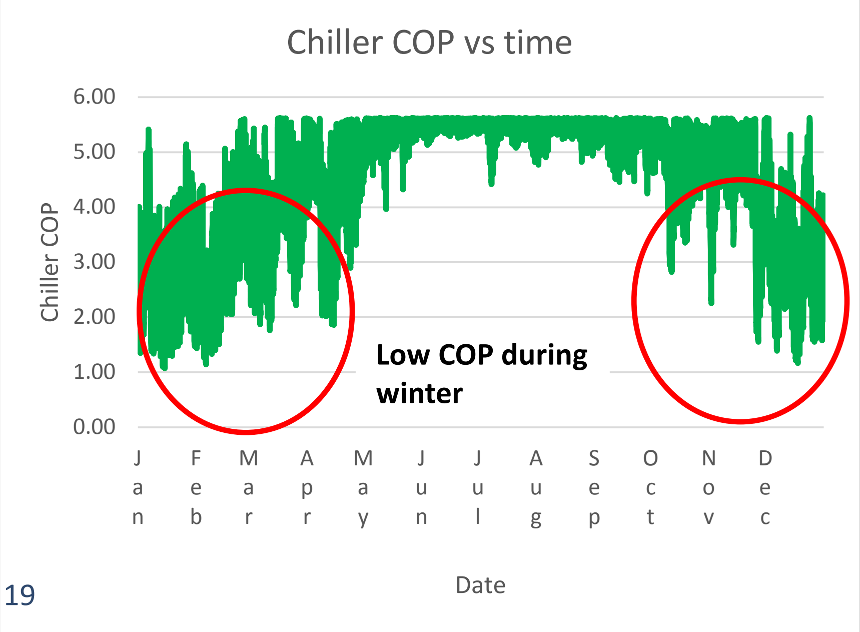
Chiller COP vs Time
with CWST reset

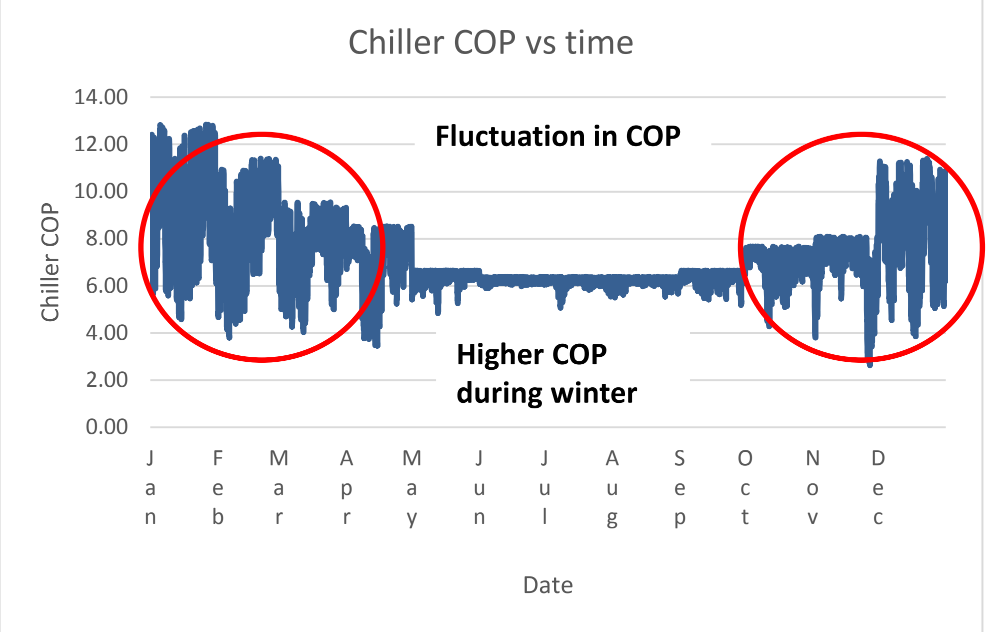
EMSD

Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)

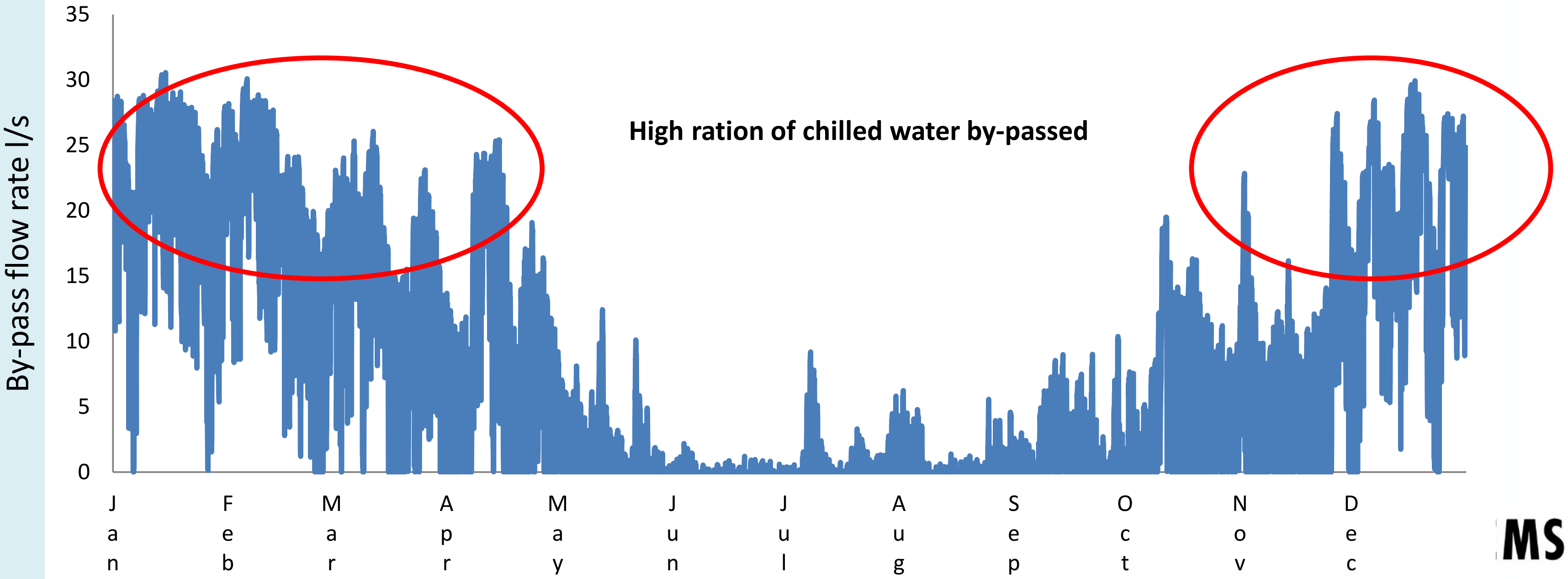




Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)



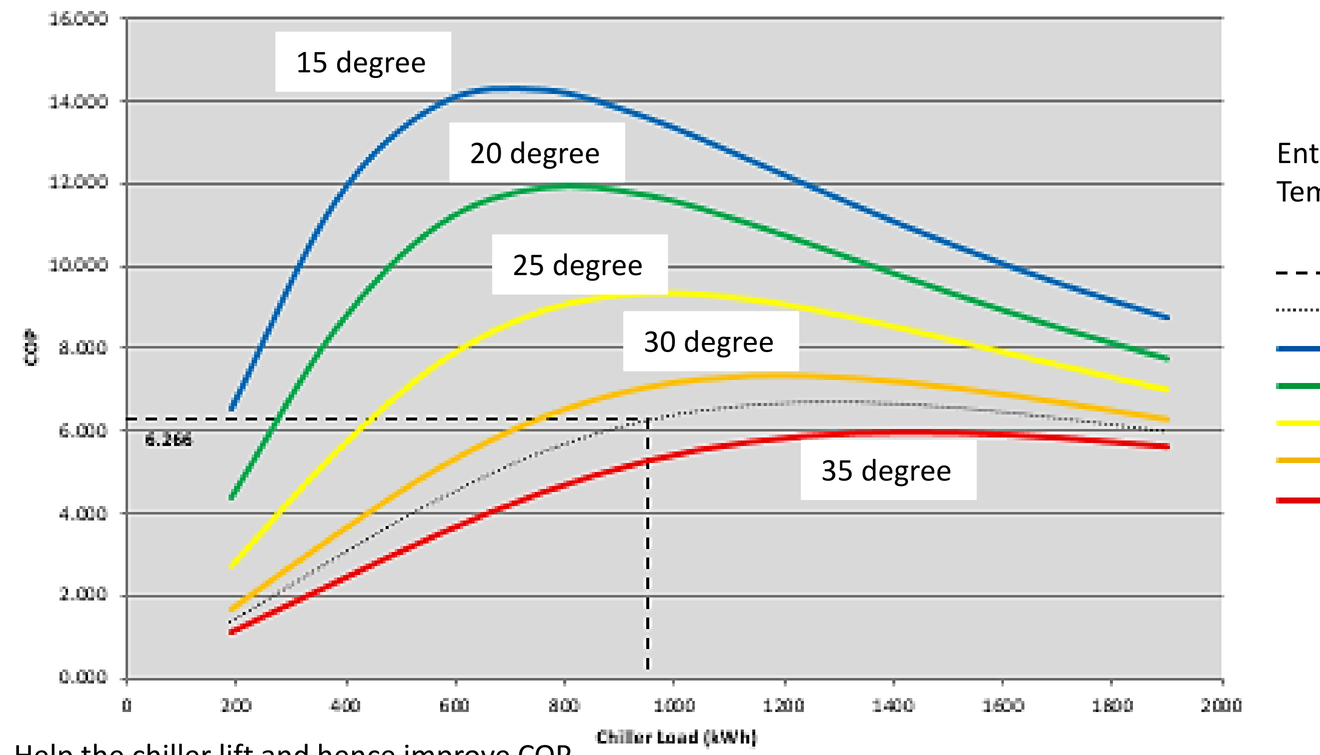
MSD

Retro-commissioning (RCx)

Date	Time	Supply water flow (l/s)	Bypass pipe water flow (l/s)
Thu, 15/Jan	0:30	8.84	31.43
	1:30	8.58	31.69
	2:30	8.25	32.01
	3:30	7.99	32.28
	4:30	7.7	32.57
	5:30	7.49	32.78
	6:30	9.73	30.54
	7:30	13.09	27.18
	8:30	13.06	27.21
	9:30	17.56	22.7
	10:30	20.2	20.07
	11:30	20.97	19.3
	12:30	21.61	18.66
	13:30	22.18	18.09
	14:30	23.24	17.03
	15:30	24.33	15.94
	16:30	22.11	18.15
	17:30	17.43	22.84
	18:30	12.43	27.84
	19:30	11.71	28.56
	20:30	10.74	29.52
	21:30	10.84	29.43
	22:30	10.17	30.1
	23:30	10.24	30.02

Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization



Help the chiller lift and hence improve COP

Entering Condensate water Temperature

- **Different CWST gives different Chiller performance curve**
- **Try to lower the CWST hence to improve COP**

Retro-commissioning (RCx)

Date	Time	Cooling load (kW)
Thu, 15/Jan	0:30	208.216
	1:30	201.867
	2:30	194.728
	3:30	188.3
	4:30	182.116
	5:30	176.673
	6:30	229.057
	7:30	305.556
	8:30	305.103
	9:30	408.651
	10:30	469.693
	11:30	487.285
	12:30	502.139
	13:30	512.658
	14:30	542.107
	15:30	562.703
	16:30	515.626
	17:30	405.232
	18:30	289.249
	19:30	273.944
	20:30	251.902
	21:30	254.797
	22:30	238.44
	23:30	240.323

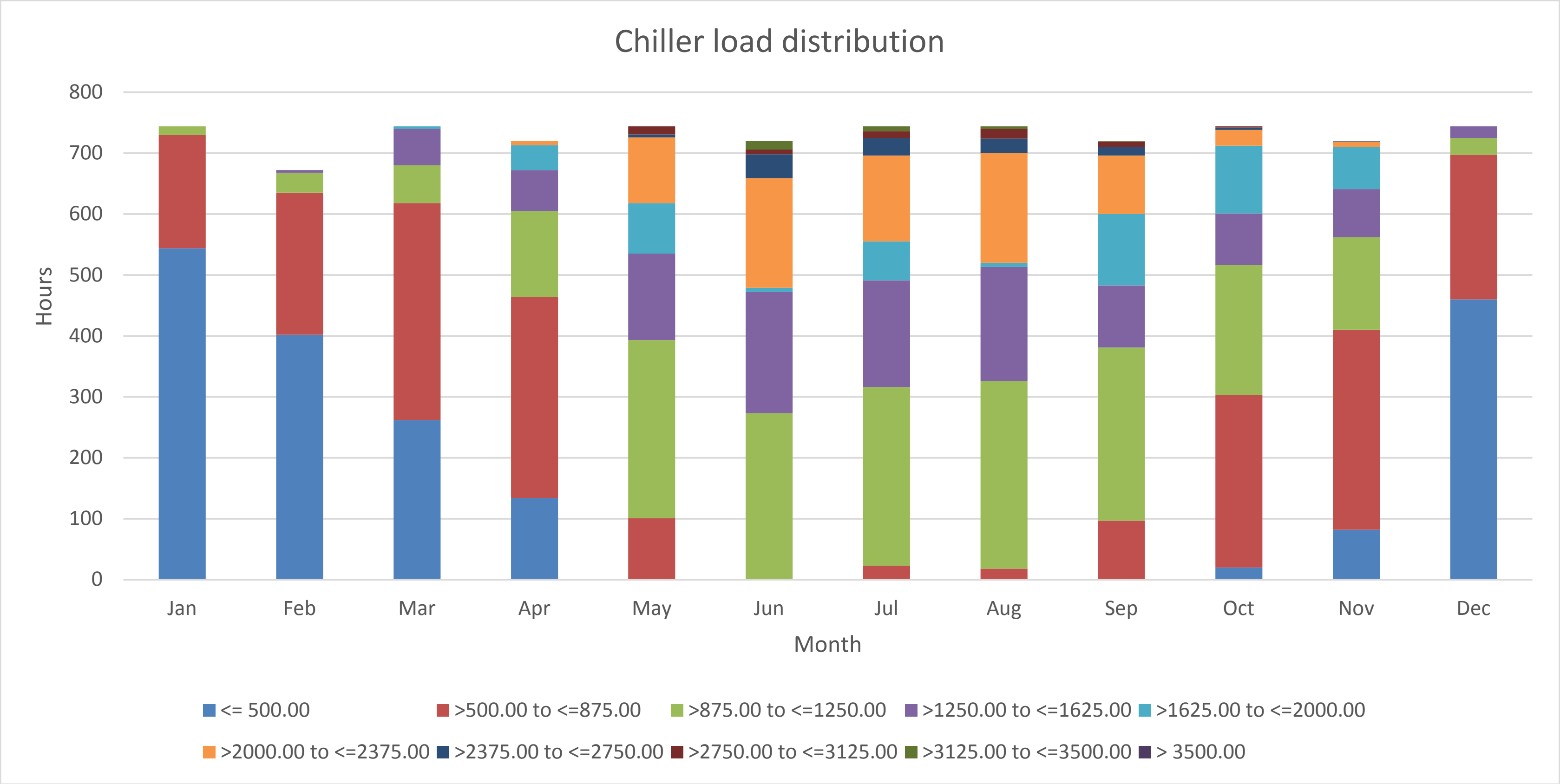
(540TR, 1900kW) WCC ~10% → (225TR, 790kW) WCC ~25%

(540TR, 1900kW) WCC ~25% Or (225TR, 790kW) WCC ~60%

(540TR, 1900kW) WCC ~13% → (225TR, 790kW) WCC ~30%

EMSD

Retro-commissioning (RCx)



Modes table

Operation Mode	Building load	No. of chiller reuiqred	Chiller to operate	No of cooling tower to operate
A	< 500kW	1	WCC1	2
B	500kW < and < 1700kW	1	HRC1/HRC2/WCC2/WCC3	2
C	1700kW < and < 3000kW	2	HRC1/HRC2/WCC2/WCC3 and HRC1/HRC2/WCC2/WCC3	3
D	> 3000kW	3	HRC1/HRC2/WCC2/WCC3 and HRC1/HRC2/WCC2/WCC3 and HRC1/HRC2/WCC2/WCC3	4

	Loading range	Suggested operation mode	Loading range	Suggested operation mode	Loading range	Suggested operation mode	Remarks
January	< 500kW	A	500kW < and < 1700kW	B	> 1700kW	B	Note 1
February	< 500kW	A	500kW < and < 1700kW	B	> 1700kW	B	Note 1
March	< 500kW	A	500kW < and < 1700kW	B	> 1700kW	B	Note 1
April	< 500kW	A	500kW < and < 1700kW	B	> 1700kW	B	Note 1
May	500kW < and < 1700kW	B	1700kW < and < 3000kW	C	> 3000kW	C	-
June	500kW < and < 1700kW	B	1700kW < and < 3000kW	C	> 3000kW	C	-
July	500kW < and < 1700kW	B	1700kW < and < 3000kW	C	> 3000kW	D	-
August	500kW < and < 1700kW	B	1700kW < and < 3000kW	C	> 3000kW	D	-
September	500kW < and < 1700kW	B	1700kW < and < 3000kW	C	> 3000kW	D	-
October	< 500kW	A	500kW < and < 1700kW	B	> 1700kW	B	Note 1
November	< 500kW	A	500kW < and < 1700kW	B	> 1700kW	B	Note 1
December	< 500kW	A	500kW < and < 1700kW	B	> 1700kW	B	Note 1

Notes

1. If loading more than 1 chiller capacity, extra chiller to be kick in

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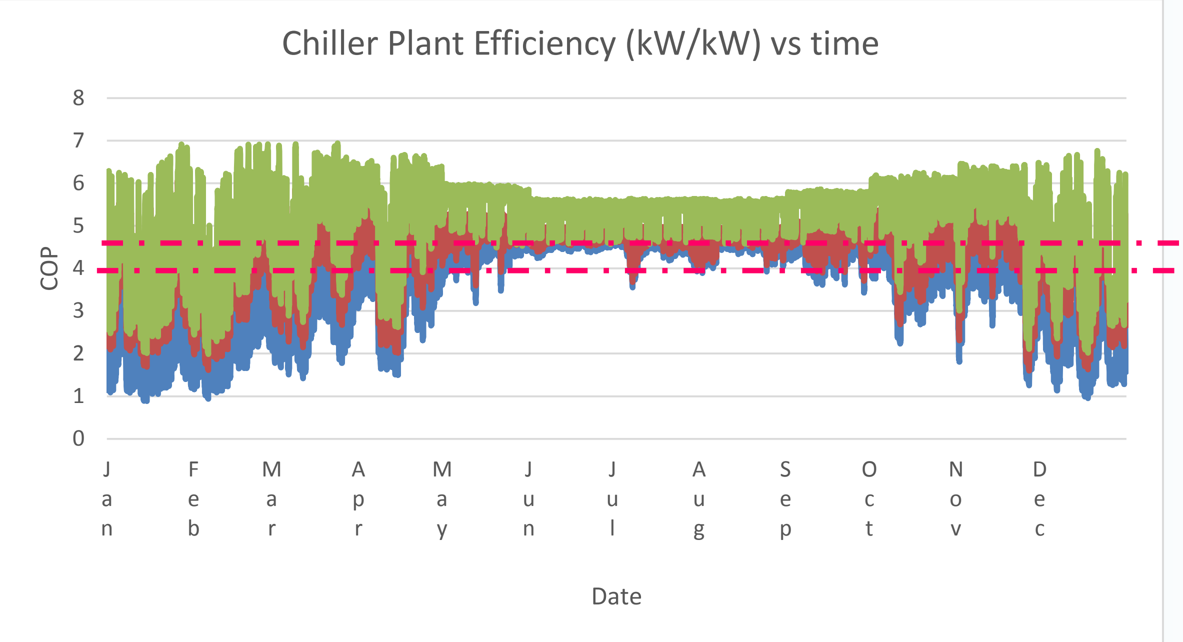
Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)



COP improvement (estimated by simulation)

Approx. 5 -10%

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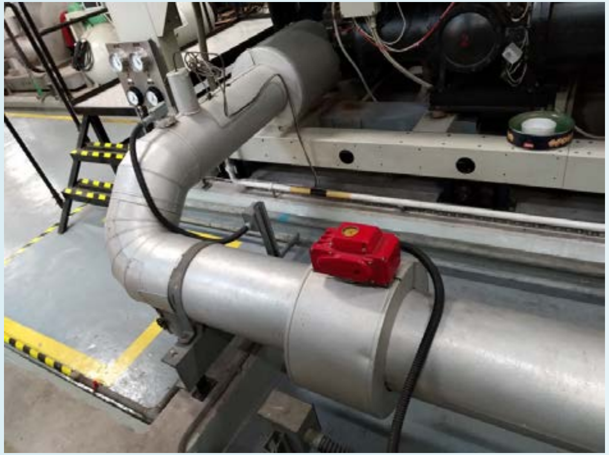
Retro-commissioning (RCx)

Example 17 – Chillers Plant Optimization

ESO: Improving Cooling Tower and Chiller sequencing (by computer simulation)

Facility / Equipment



Observation

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