FOCUS ENERGY SOLUTIONS

Independent Building Automation & Energy Management

Healthcare Environmental Sustainability Forum

Building Commissioning, Energy Efficiency & Building Automation Systems

June 1st 2017

Overview

- Focus Energy Solutions Introduction
- Building Commissioning , Re-commissioning & Tuning
- Practical Examples of Energy Saving

Focus Energy Solutions

- Focus Energy Solutions is a team of experienced Building Automation and Energy Management Consulting Engineers from a range of building services backgrounds. This includes Building Automation & Controls, HVAC and Facility Management.

- We specialise in implementing engineering and commissioning standards, ensuring compliance and verification that correct processes are followed to achieve the requirements specified by our clients. We do this with a predominate focus on the BMS is this is the system that ties all other building services together and has the greatest impact on ensuring the building is fit for its intended purpose and energy consumption is minimised.

- Focus Energy Solutions take an active role, often going above and beyond the scope providing “hands on” advice and direction for any associated services and integration requirements ensuring a fully operating and efficient building.

What is Building Commissioning

- “The aim of commissioning new buildings is to ensure that they deliver, if not exceed, the performance and energy savings promised by their design. When applied to existing buildings re-commissioning identifies the almost inevitable ‘drift’ from where things should be and puts the building back on course”

- “Commissioning is more than just an energy saving measure. It’s a risk management strategy that should be integral to any systematic approach to garnering energy savings and emissions reductions.”

- *“Mills,E (2009) Building Commissioning – A golden opportunity for reducing energy costs and greenhouse gas emissions”*

BMS Commissioning Issues

Insufficient time in construction program allowed for adequate commissioning and verification

Project becomes a D&C and 'value management 'is applied

No responsibility or ownership taken by BAS contractor due to the contractual relationship with mechanical contractor. Only do what they are told rather than act as control specialists.

BMS contractors don't usually understand the value of a commissioning plan and importance of Functional testing, often think point to point testing is commissioning

BAS points in several different specifications, mech, elec, hydraulic.

BAS Software programmer often doesn't know what is happening in the field, less application knowledge. e.g. chiller control primary secondary system.

Not getting this right can lead to long term issues of comfort as well as increased energy cost

BMS Feedback to reduce operating cost

Include supply air sensors for interrogation, commissioning, feedback, temperature control and maintenance. Get as much feedback as possible so that the FM can fault find quickly and not just rely on what the BAS says the output is. Heating and cooling on at the same time can give a good room temp.

Include filter differential pressure sensor not pressure switch

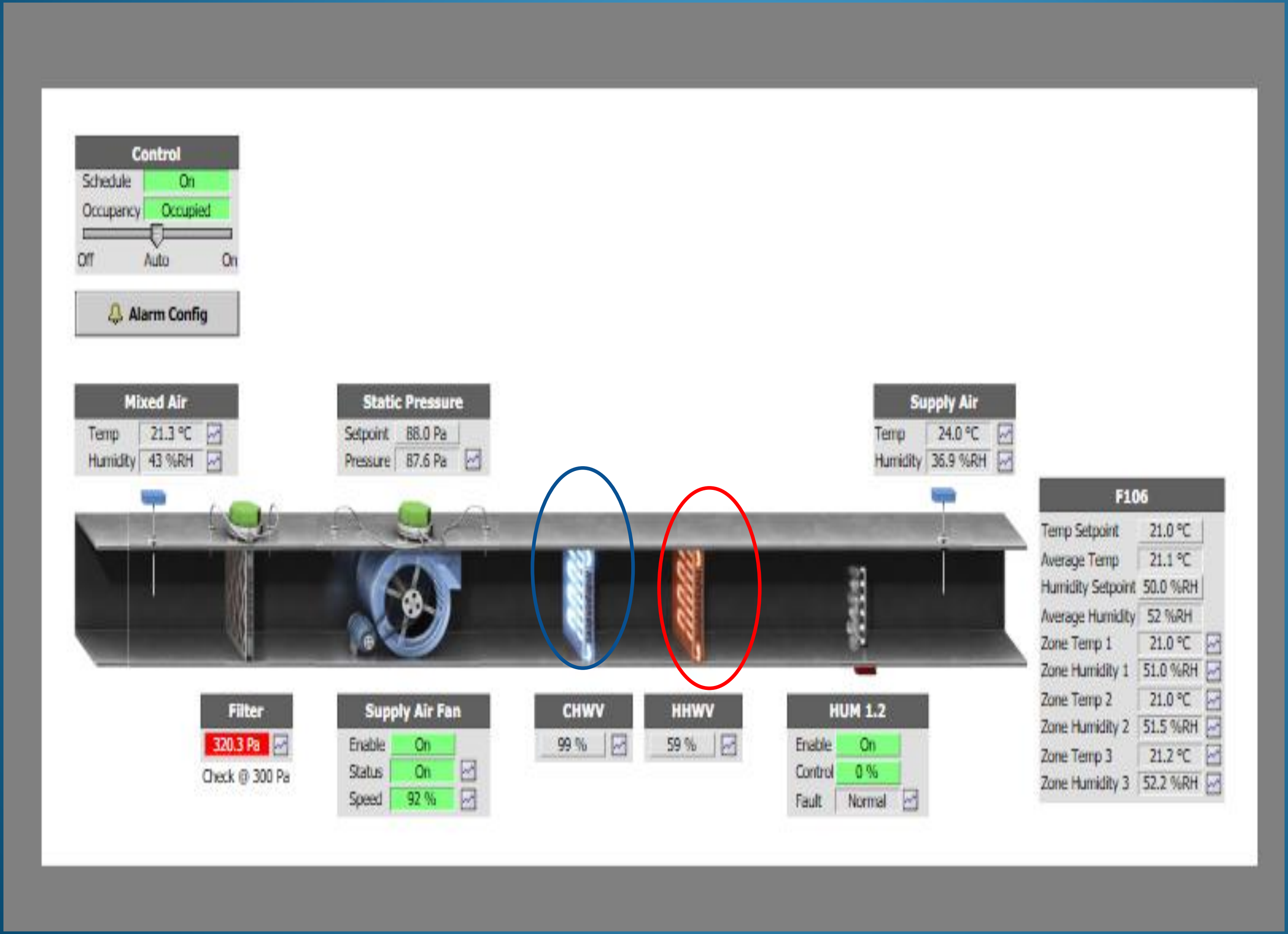
Monitor refrigeration compressor status – used to monitor cycle times

Monitor sump pump/sewage pump status – used to monitor cycle times

For AHU’s with economy cycles include a mixed air temperature sensor – this will provide feedback on the correct operation of the economy cycle

Often the first things to be deleted , but over the life of the project are well worth the small investment

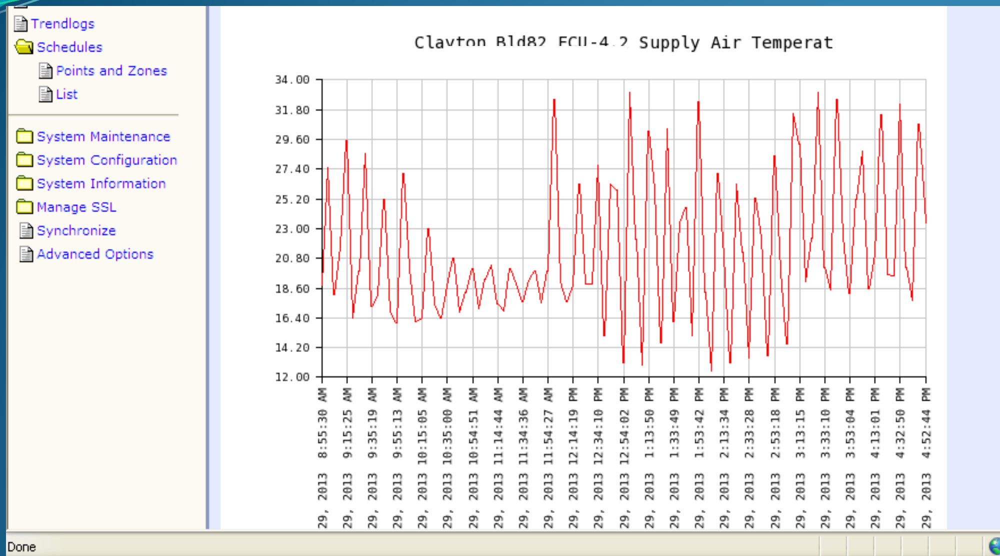
Commissioning Investigation



Heating & Cooling on at same time

Trying to control humidity without any dead band

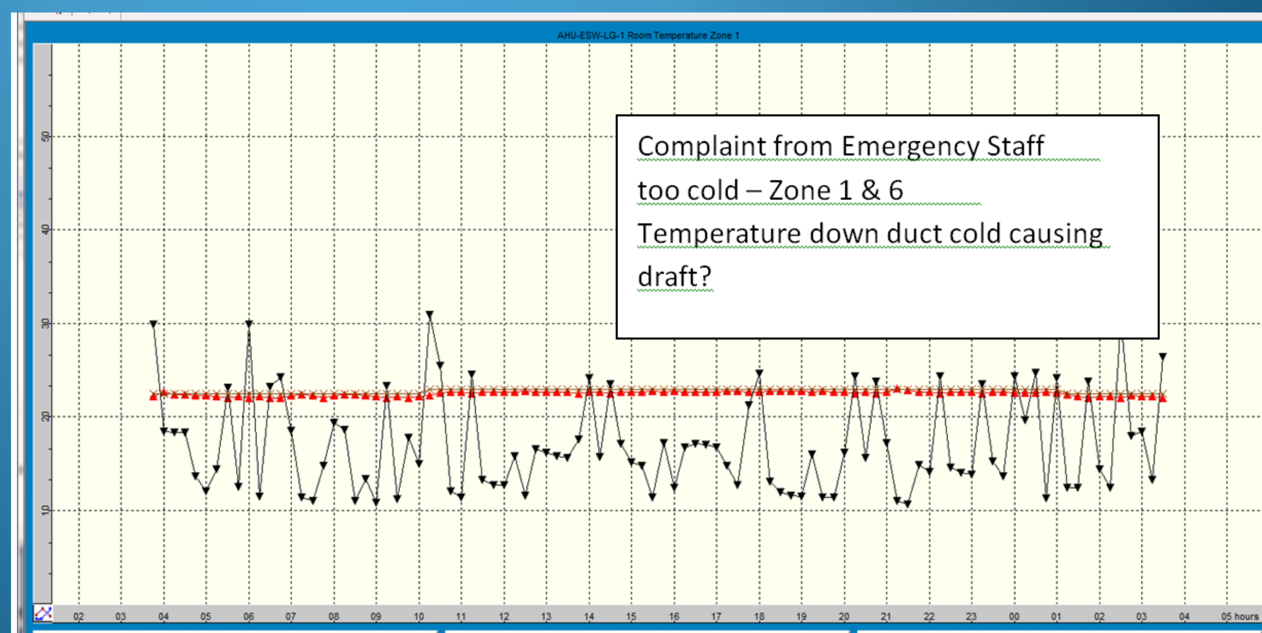
Commissioning Investigation



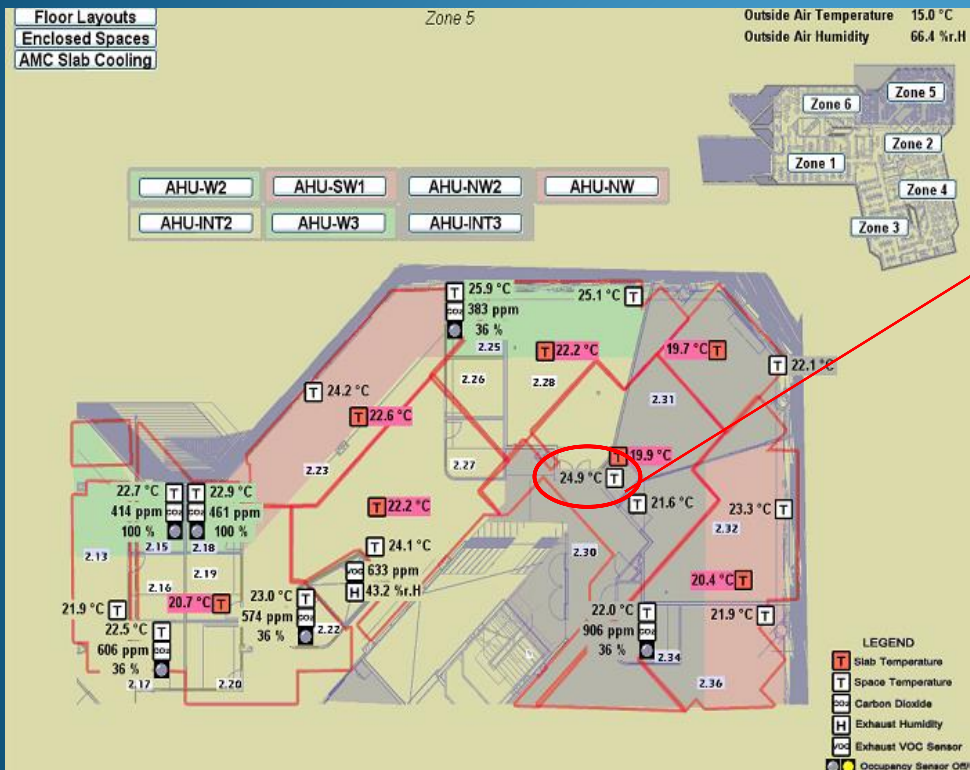
Unstable control loops

PID control and tuning.

Log of room temperature , set point and supply air temperature – shows times where cold air dumps and requires tuning



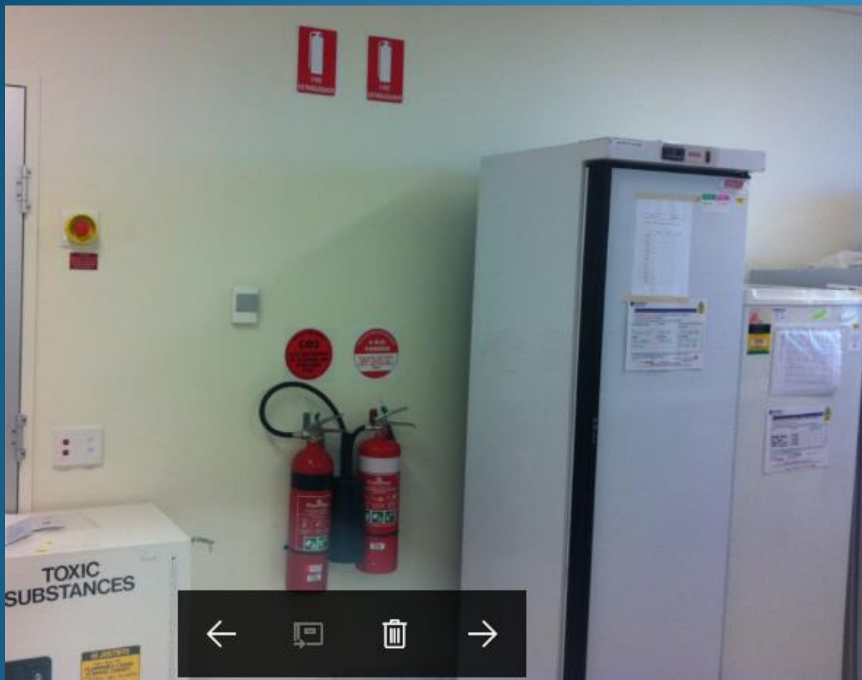
Commissioning Investigation



Hot wire shows temp of 21.5’c not 24.9 on graphic

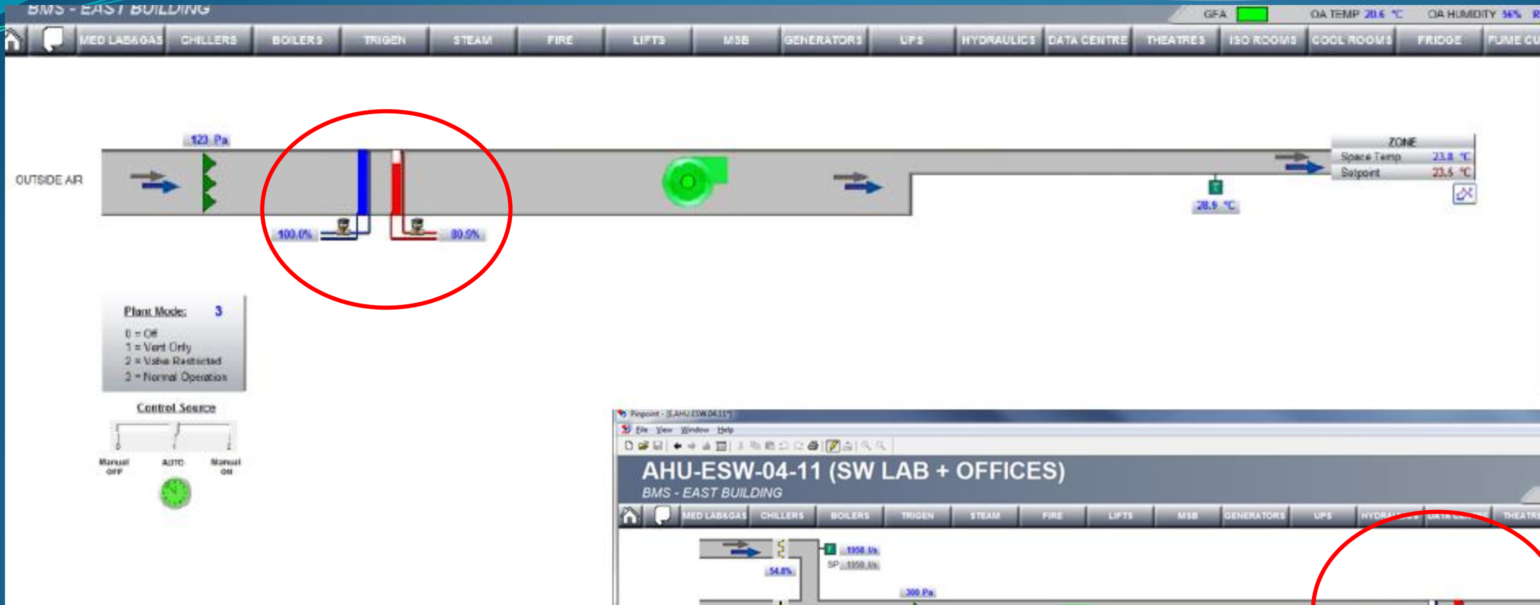
Temperature sensors not calibrated or zones crossed

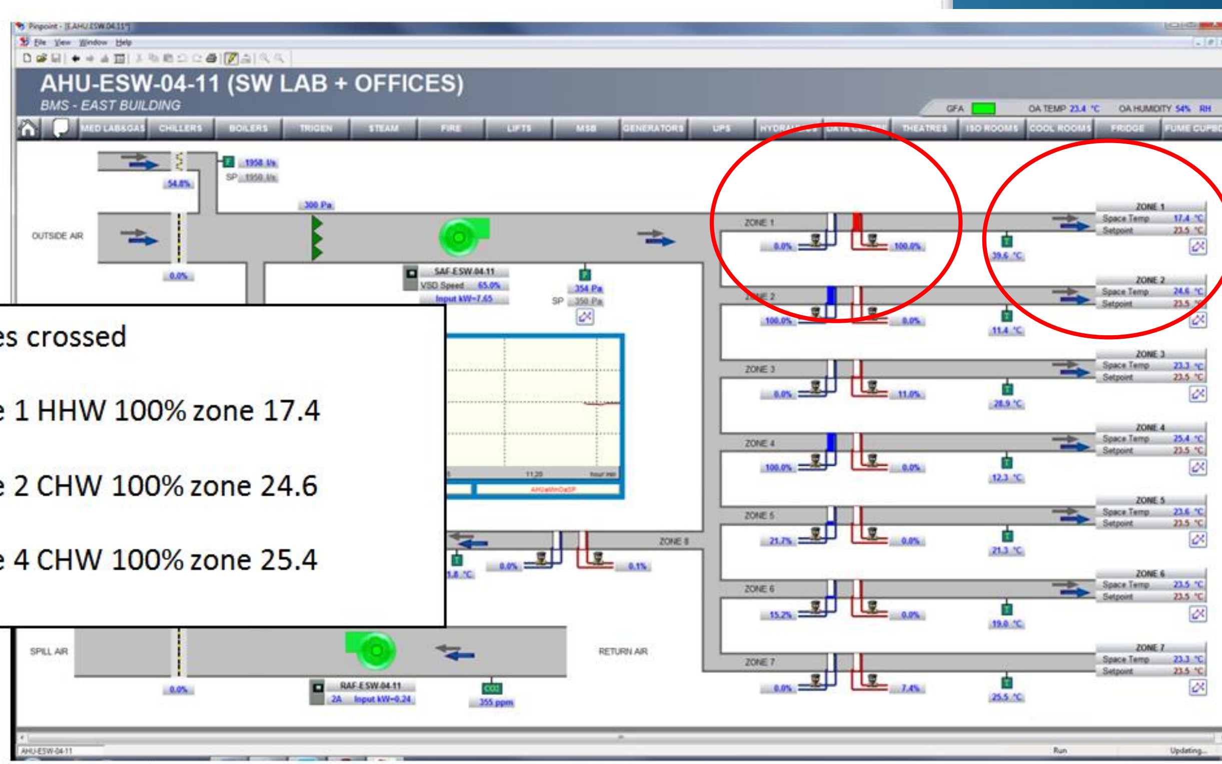
Commissioning Investigation



Incorrect placement of zone temperature sensor affecting conditions in other parts of the zone

Commissioning Investigation





Example of heating & cooling valve open at same time

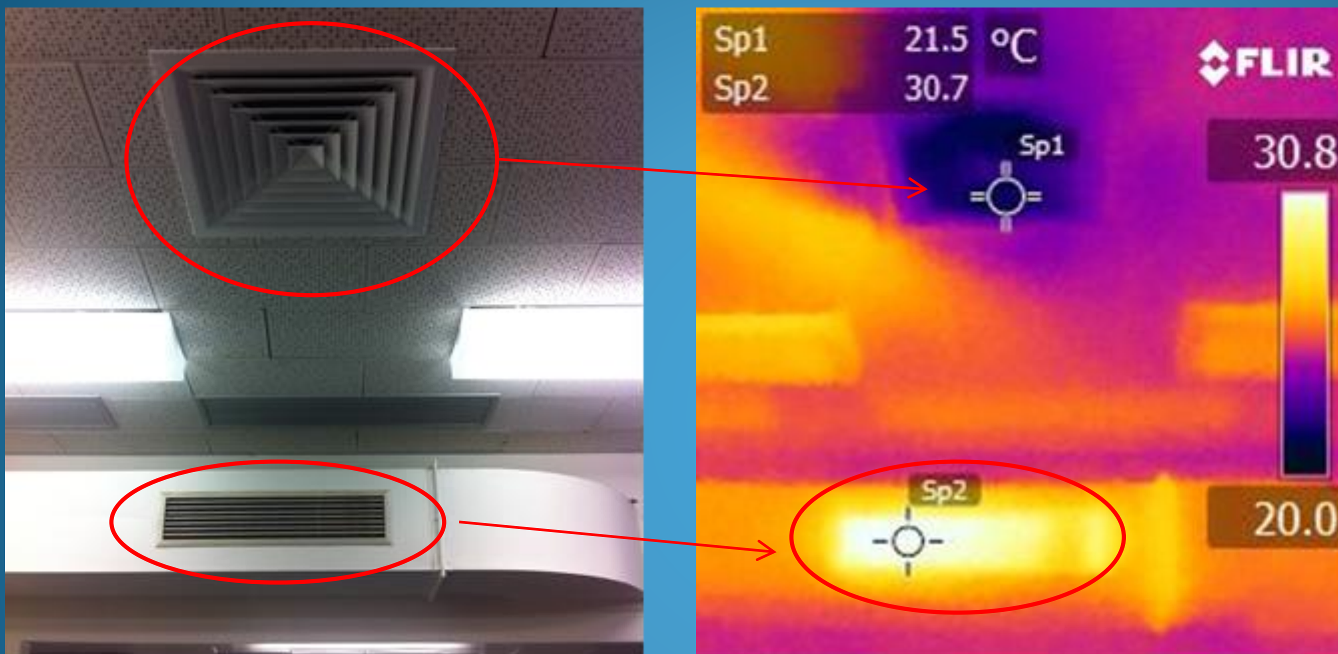
Zones crossed

Zone 1 HHW 100% zone 17.4

Zone 2 CHW 100% zone 24.6

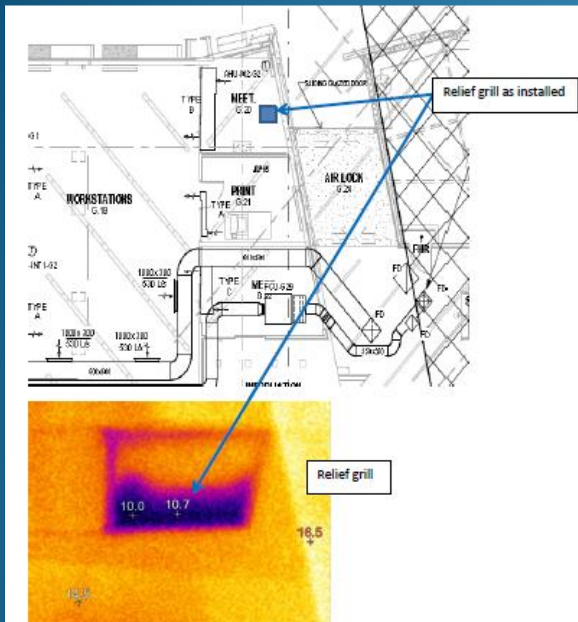
Zone 4 CHW 100% zone 25.4

Commissioning Investigation

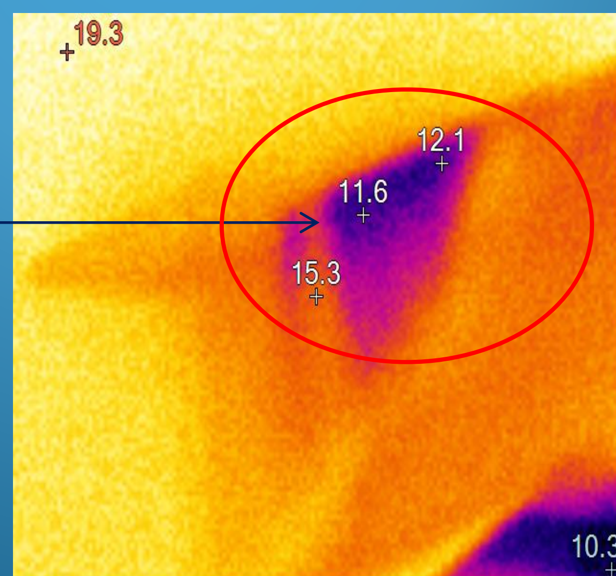


Thermal images shows base building system on heating (30.7'c) while the DX FCU is on cooling (21.5'c). System integration had not be commissioned correctly.

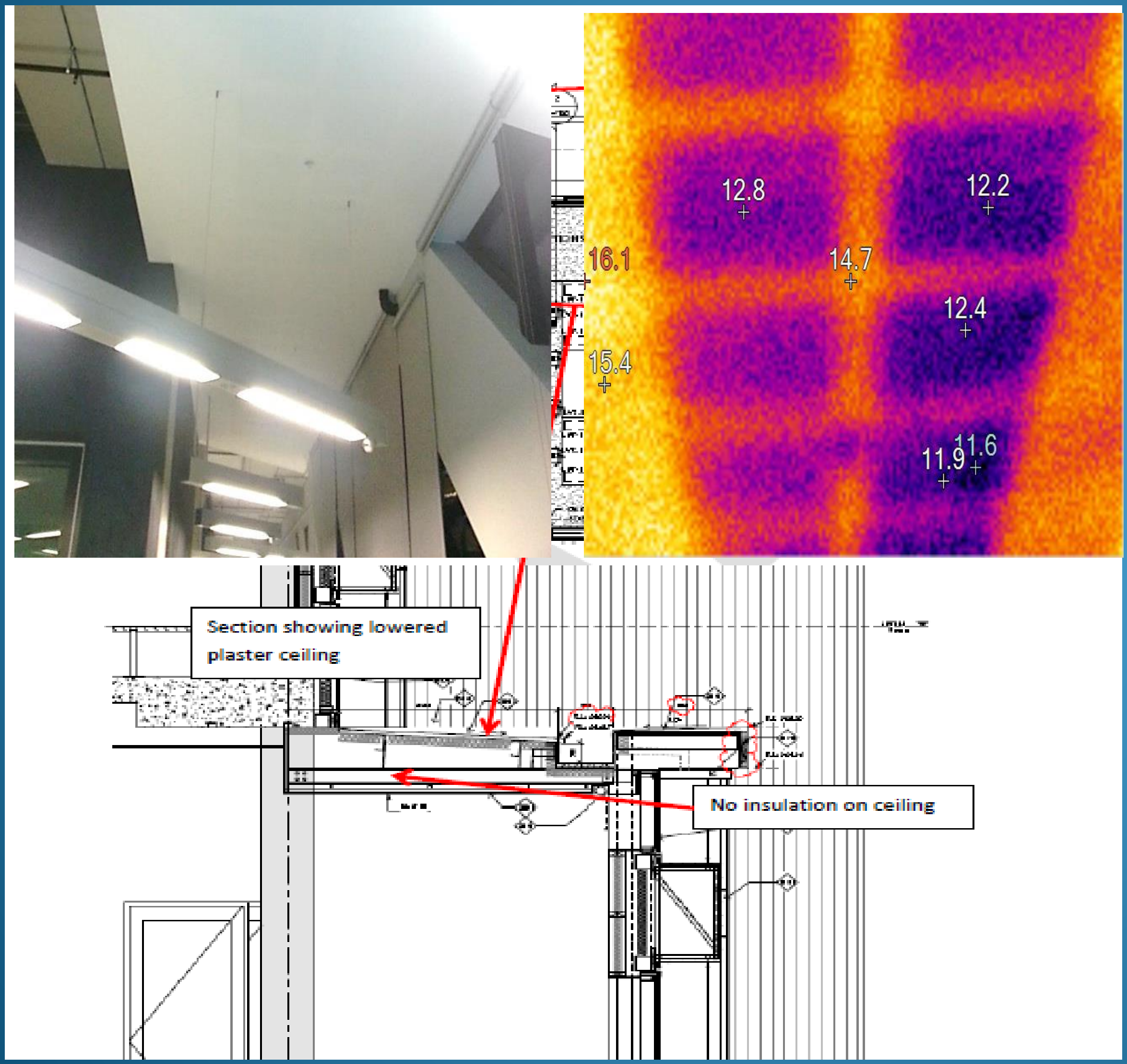
Commissioning Investigation



Facade not sealed adequately cold air entering building



Commissioning Investigation



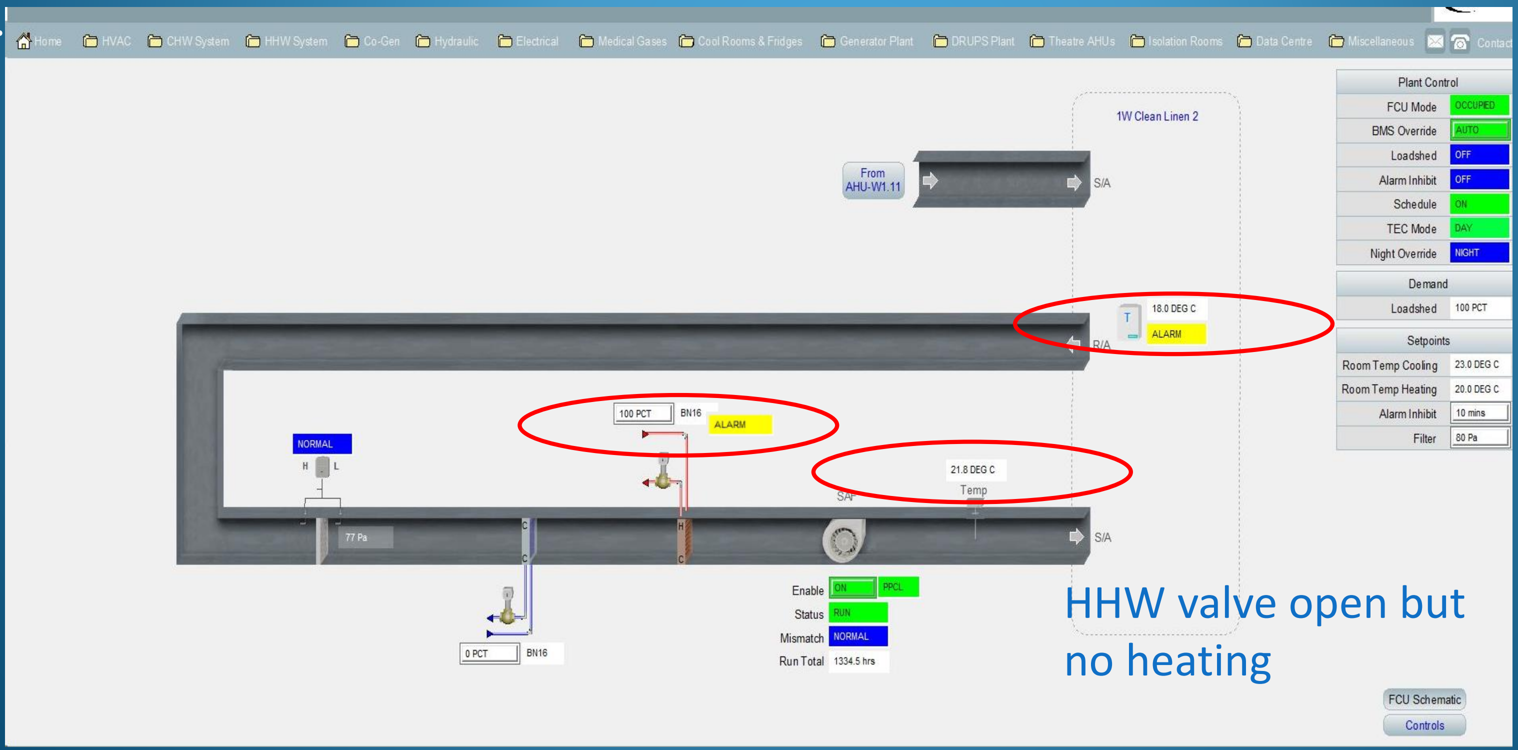
No insulation in the ceiling

Alarms to Assist with Energy Monitoring

Energy Alarms:

Room Temperature Alarm

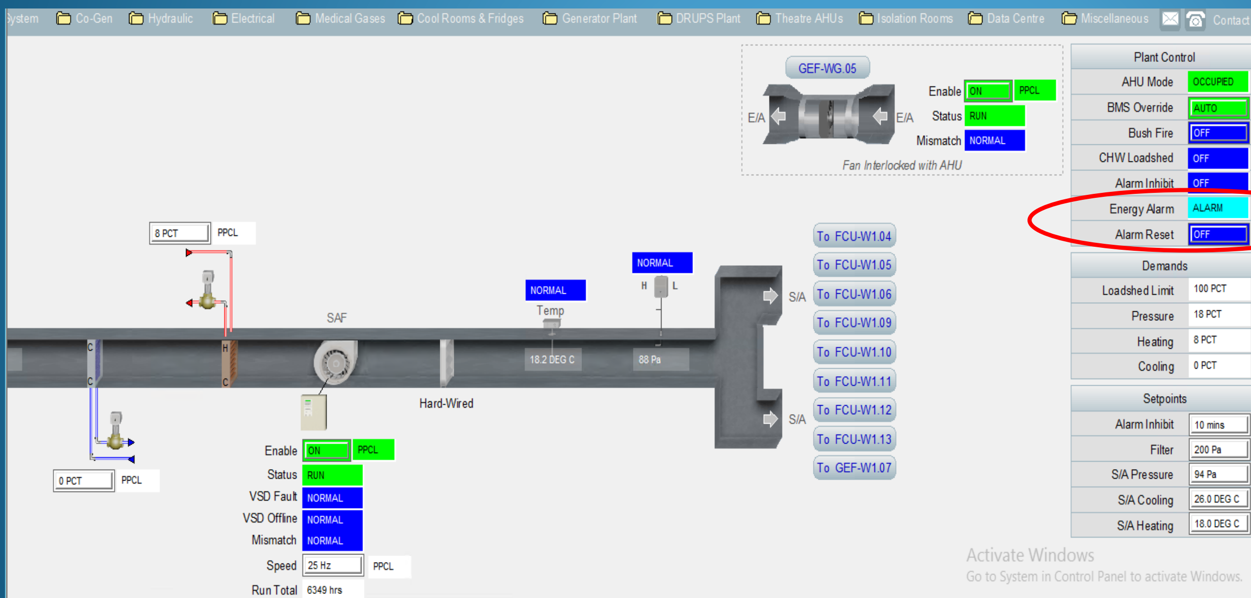
Alarm if Heating or Cooling Valve Open 100% for longer than 4 hrs (adj)



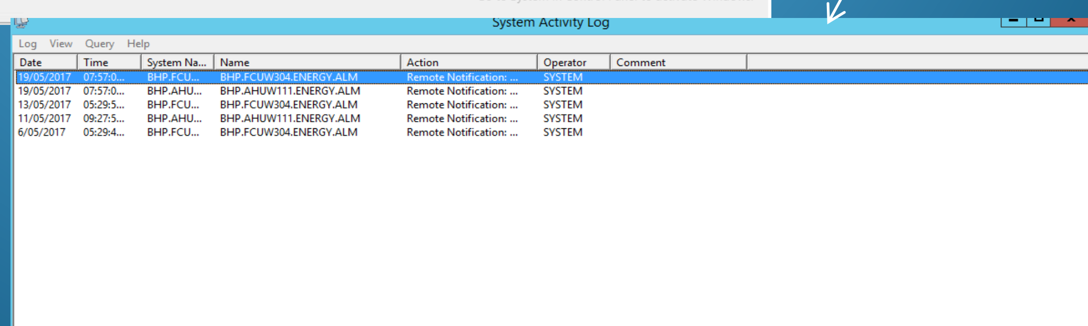
Alarms to Assist with Energy Monitoring

Energy Alarms:

Non 24/7 Units Alarm if Fan status on for > 12 hrs (adj)



Report log of Energy Alarms

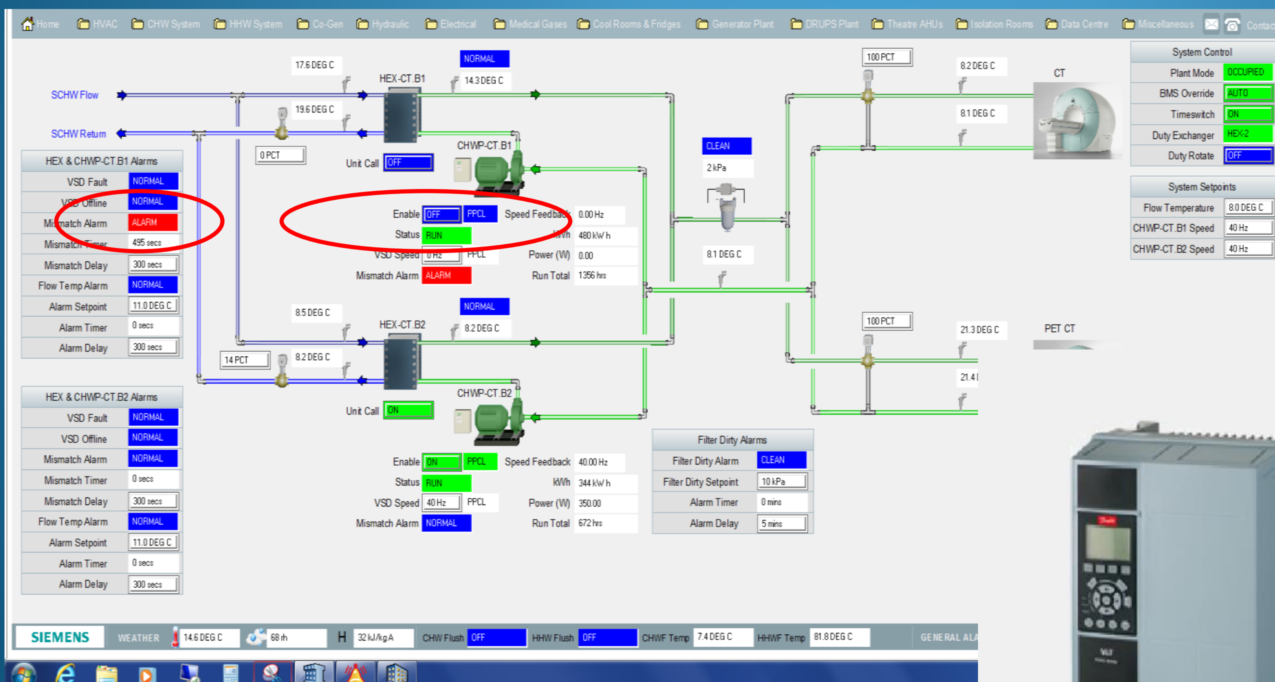


Date	Time	System Na...	Name	Action	Operator	Comment
19/05/2017	07:57:0...	BHP.FCU...	BHP.FCUW304.ENERGY.ALM	Remote Notification: ...	SYSTEM	
19/05/2017	07:57:0...	BHP.AHU...	BHP.AHUW111.ENERGY.ALM	Remote Notification: ...	SYSTEM	
13/05/2017	05:29:5...	BHP.FCU...	BHP.FCUW304.ENERGY.ALM	Remote Notification: ...	SYSTEM	
11/05/2017	09:27:5...	BHP.AHU...	BHP.AHUW111.ENERGY.ALM	Remote Notification: ...	SYSTEM	
6/05/2017	05:29:4...	BHP.FCU...	BHP.FCUW304.ENERGY.ALM	Remote Notification: ...	SYSTEM	

Alarms to Assist with Energy Monitoring

Energy Alarms:

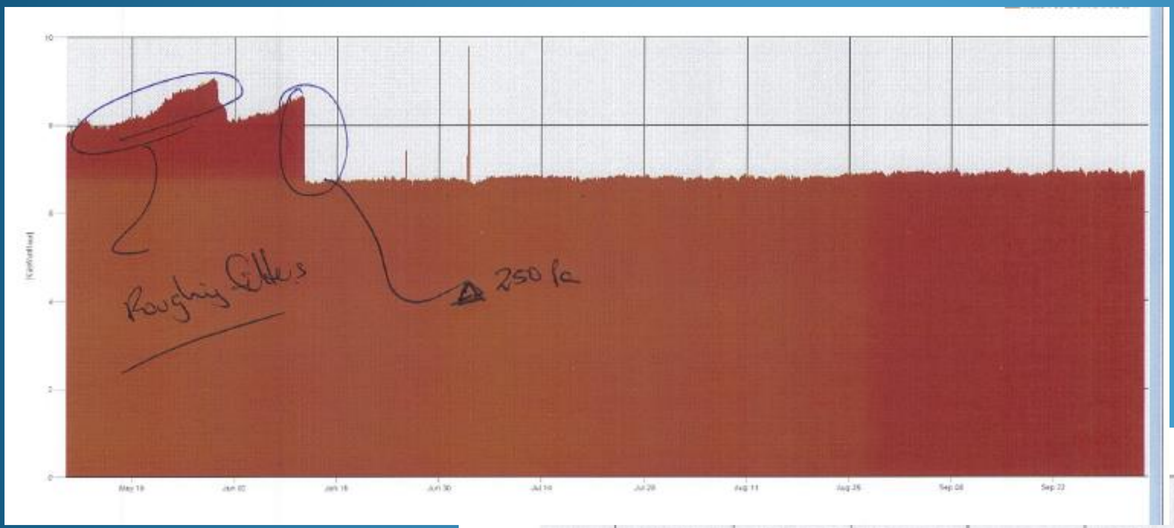
- Alarm Pump Status & Enable Mismatch (Both ways)
- VSD in Manual alarm

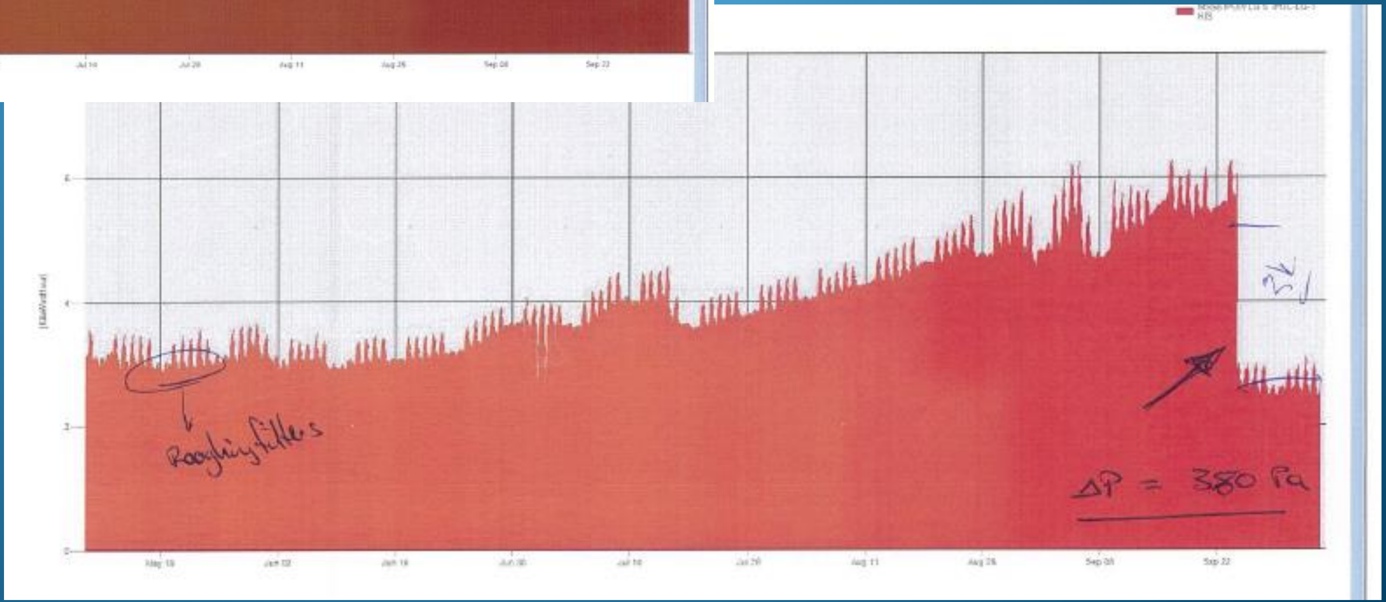


Alarms to Assist with Energy Monitoring

Filter pressure alarms often set on arbitrary figure (400pa)

By logging filter differential pressure and fan kw via VSD then can determine optimal time for replacement





Practical Examples of Energy Efficiency

Practical Examples of Energy Efficiency

“If you cannot measure it, you cannot improve it” *Peter Ducker*

Make someone responsible of energy reporting

Annually calibrate global outside air & humidity sensors as these sensors affect the operation of economy cycles and de-humidification cycles

Obtain as much feedback from the BMS as possible , Including Energy Meters, Thermal Meters to calculate COP, HLI information from VSD’s including kw & kwh

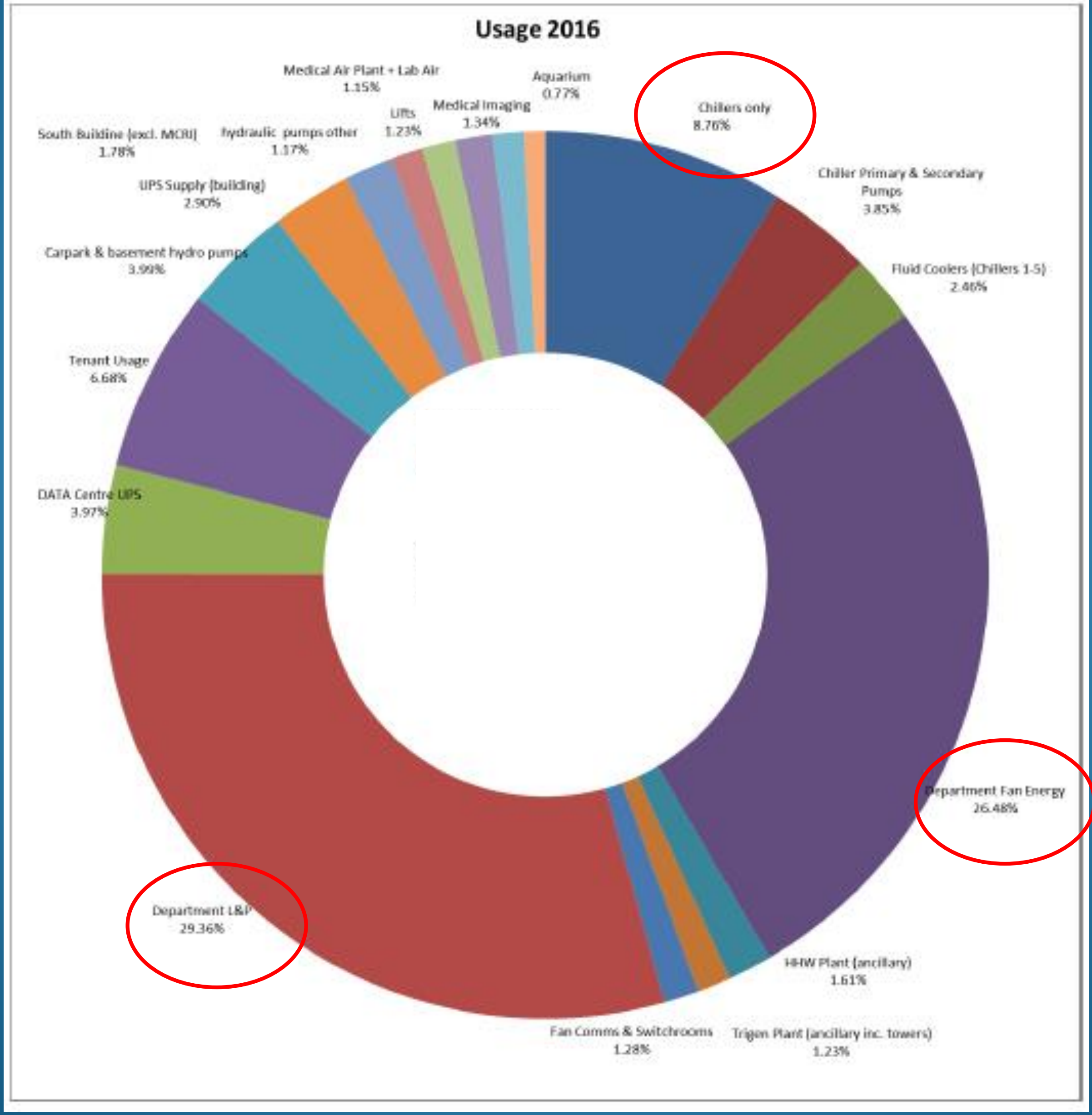
Install sub-meters on high consumers of energy

Install leak detection alarms on water meters

Install alarms on power meters to know when they are off line and not communicating

Don’t over heat or over cool, consider allowing zone temperatures to drift in summer with changes in o/a temperature

Practical Examples of Energy Efficiency



Example of where electricity is used – concentrate on large consumers as these areas can make the biggest difference

Practical Examples of Energy Efficiency

Undertake regular Review of AHU hours of operation

Objectives

Review of air handling unit time schedules with [redacted] management and confirm that the current time schedules match the requirements of each department. (non 24/7 areas only)

Results /Observations

A review of the normal operational hours for each department was undertaken with management and compared with the current BMS time schedules and were adjusted accordingly.

The following changes were made and the potential savings are outlined below:

To each of these areas a public holiday schedule was added (ie AHU off during public holidays)

AHU-ENW-01-1 (Allied Health) was 7am-10pm now 7am-7pm saving of 3 hrs per day (9kw/hr)

AHU-ESE-01-2 (Allied Health) was 7am-10pm now 7am-7pm saving of 3 hrs per day (6kw/hr)

AHU-ESW-01-2 (Neighbourhood 4) was 8am-7pm Sat now only runs M-F saving of 11 hrs 1 day/week (5kw/hr)

FCU-ESE-01-1 (Hydro pool change room) was 24/7 now 6am-6pm 7 days saving of 12hrs day (1kw/hr)

AHU-ENE-02-27 (HACC office) was 6am-6pm sat/sun now just M-F saving 12hrs 2 days week (6kw/hr)

FCU-ENE-02-28 (HACC lounge) was 24/7 sat/sun now 6am-9pm Sat/Sun saving 9hrs 2 days week (1.5kw/hr)

Estimated Saving 27800kwh/pa @$0.11c/kwh = $3058pa excluding any central energy plant savings.

For each AHU reviewed an afterhours/exception time schedule was added. This exception can be easily added to any AHU that is required to operate outside of normal hours (see Quality Initiative I 15-13).

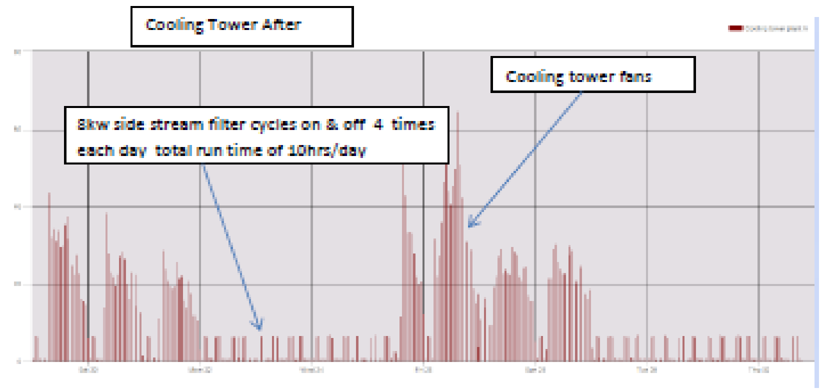
Conclusion

Most of the current air handling unit time schedules meet the requirements of the departments that they serve. As a result of the review 6 times schedules required modification.

These changes has been actioned which will result in an estimated annual saving of $3058/pa

Practical Examples of Energy Efficiency

Cooling tower
Filter time
schedule



Saving of 14hrs /day @ 8.0kw = saving of 40,800kwh/pa @ $0.09c/kwh = $3680 pa

For the 3 cooling towers the total saving = $11,000 pa

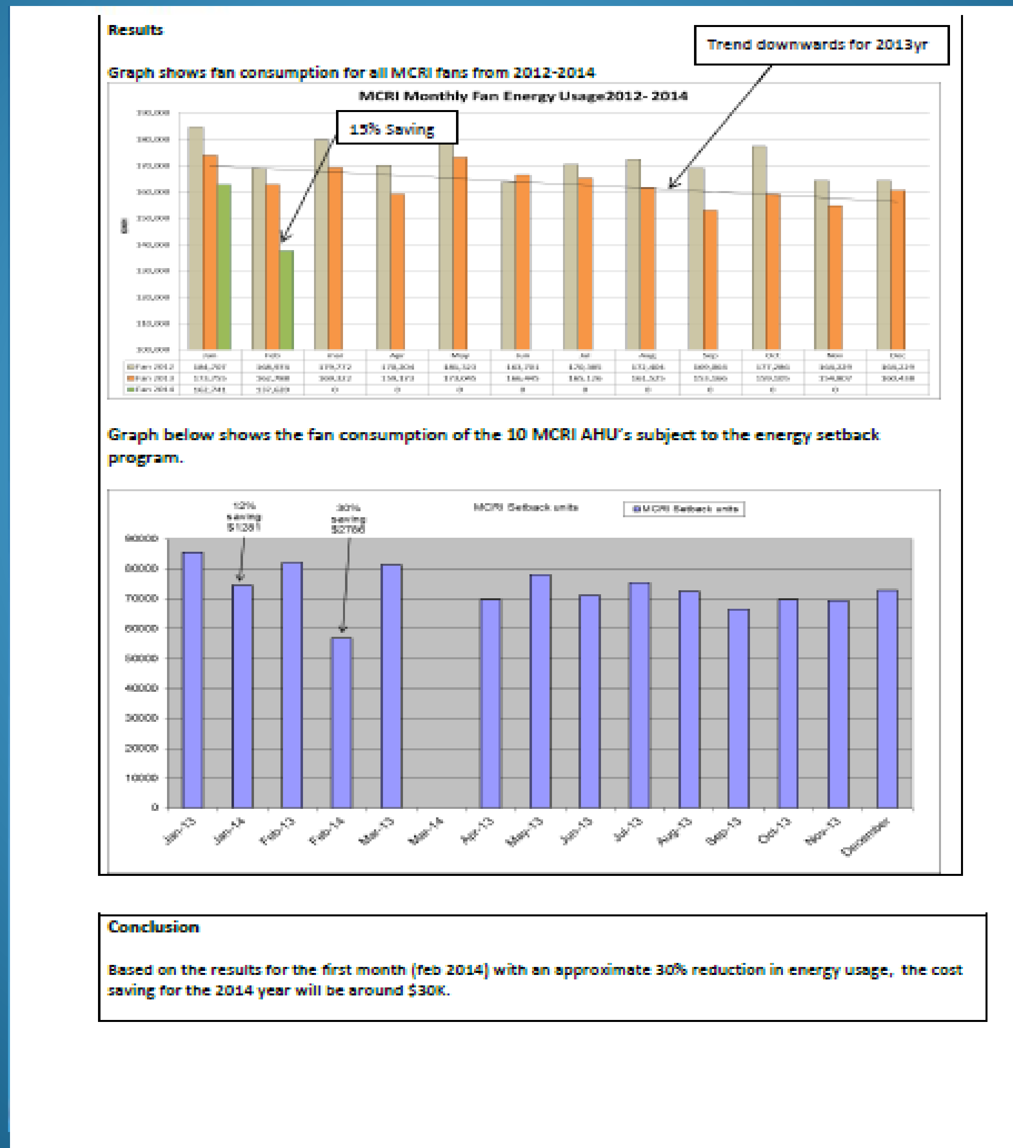
Based on the above figures there is a payback of 60 days

Conclusion

Based on the above figures the payback is 60 days

Practical Examples of Energy Efficiency

Fan setback



Results

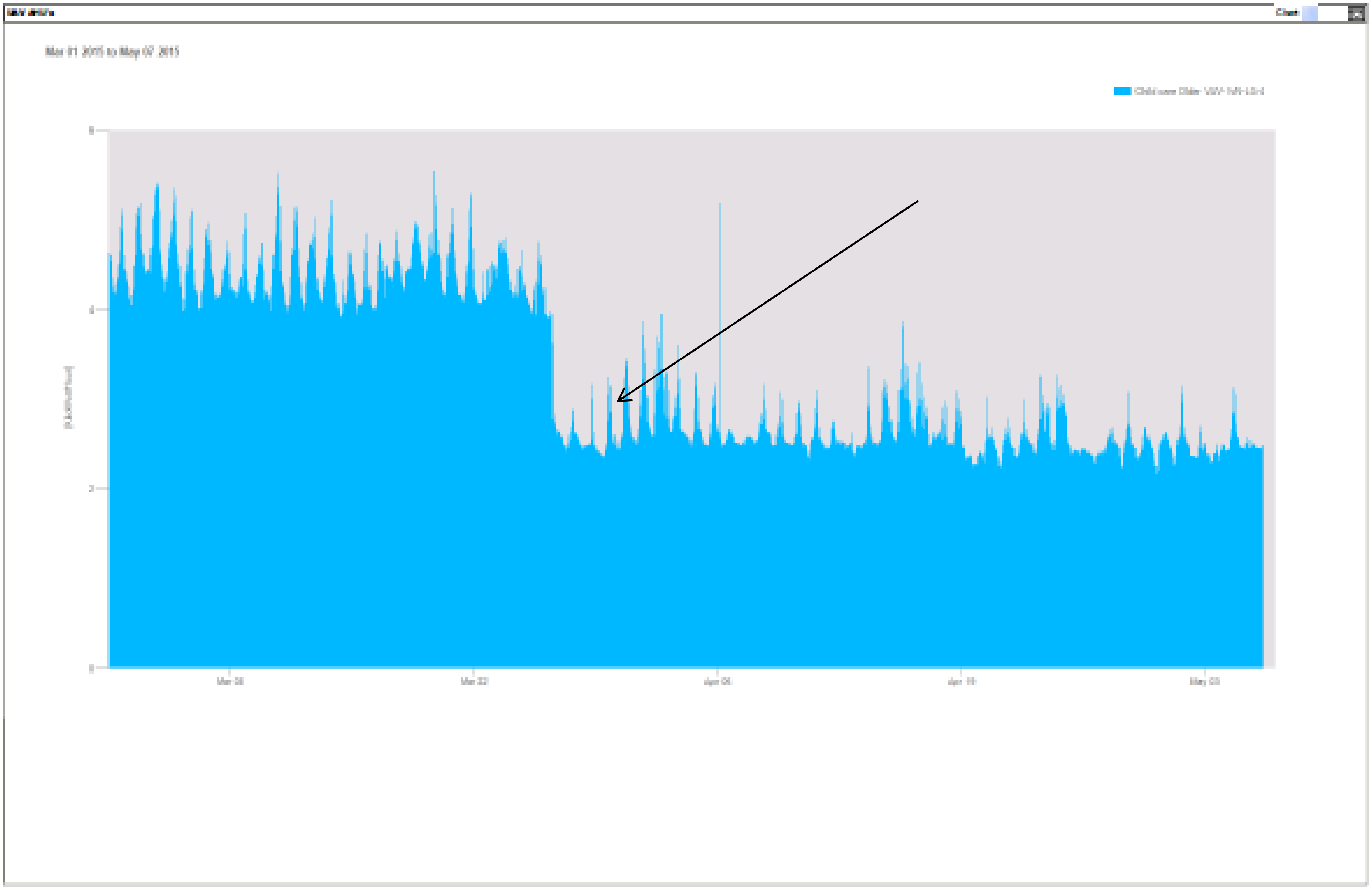
Graph shows fan consumption for all MCRI fans from 2012-2014

Graph below shows the fan consumption of the 10 MCRI AHU's subject to the energy setback program.

Conclusion

Based on the results for the first month (feb 2014) with an approximate 30% reduction in energy usage, the cost saving for the 2014 year will be around $30K.

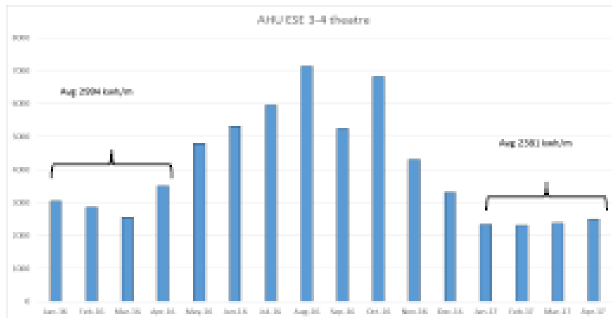
Practical Examples of Energy Efficiency



Practical Examples of Energy Efficiency

Humidity control for theatre

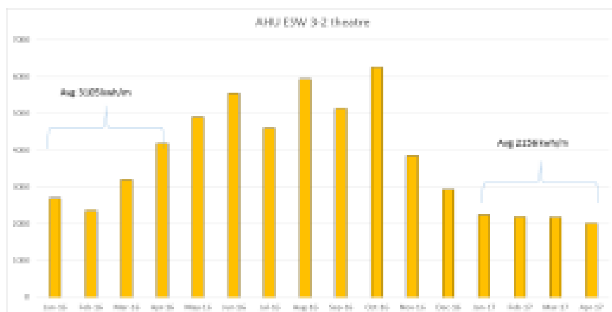
The new program has been implemented on 12 operating theatres . The majority of the savings will be seen during winter when humidification is generally needed. Examples of the savings for the first 4 months of the year for typical theatre units is shown below.



Avg. Saving

613kwh/month@$0.075

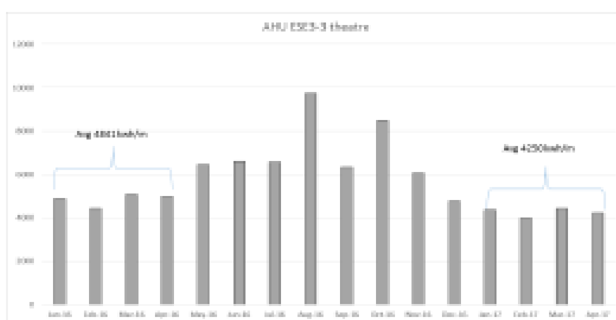
= $46/month



Avg. Saving

949 kwh/month @$0.075

= $71/month



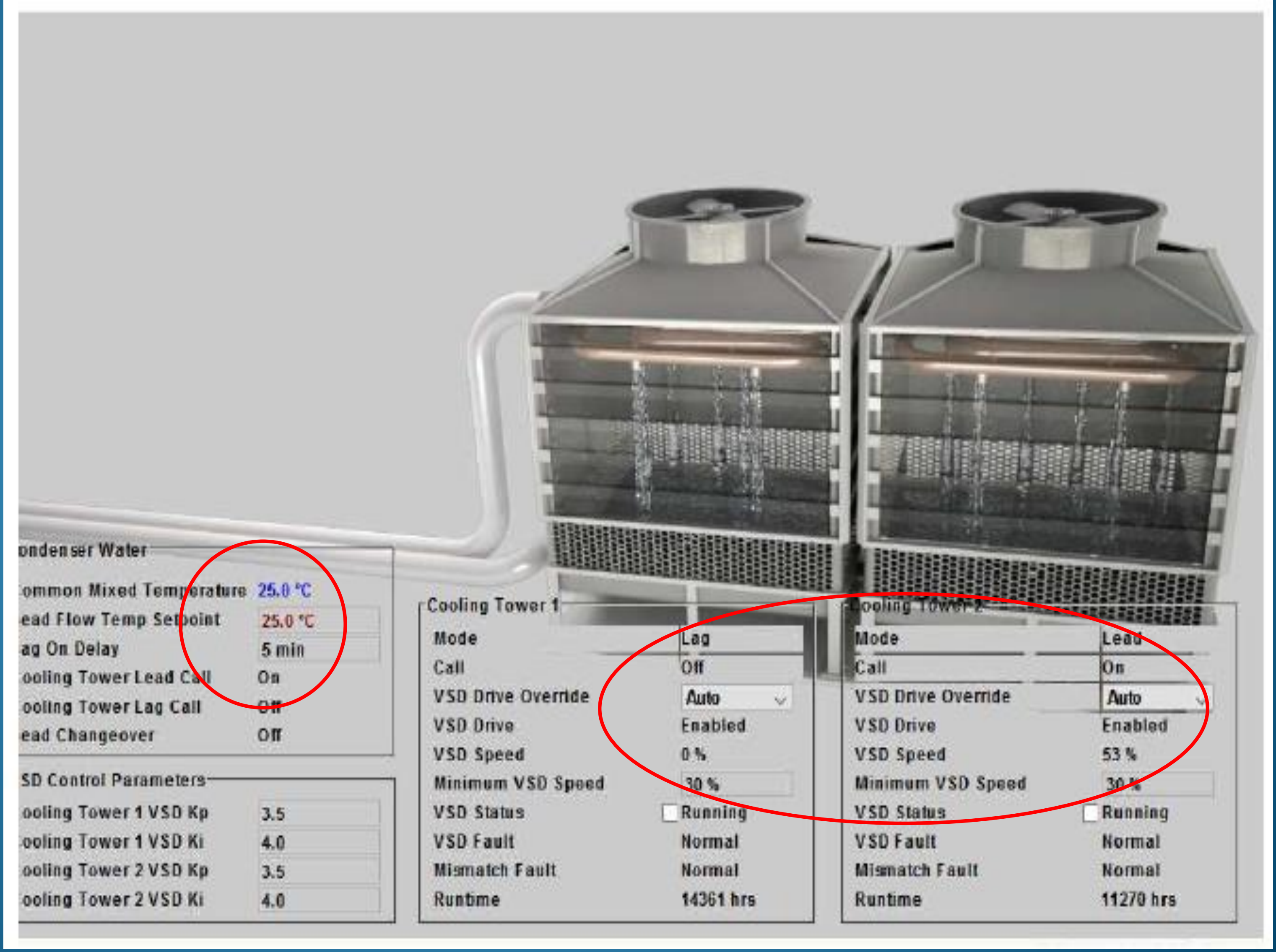
Avg. Saving

591kwh/month @$0.075

= $44/month

Practical Examples of Energy Efficiency

Cooling Towers in parallel operating Lead/Lag



Practical Examples of Energy Efficiency

Pump discharge throttled for balancing

Add vsd's to pumps

Monash University Clayton Campus
Building 13F Energy Review Version 1.0

3.1 Condenser Water Pumps

The pictures above show that in order to balance the condenser water system the discharge valve on the condenser water pump has been partially closed and the butterfly valves to each of the cooling towers have also been partially closed. Shutting the valves to balance the system creates additional resistance to the system which then requires more pump energy to overcome.

Installation of a variable speed drive on the condenser pump would enable the valves to be opened reducing the system head. Its estimated that there would be a saving of around 30% by addition of a VSD. From analysis of trend logs this pump currently runs around 90% of the time and draws 9.8 kw. Installation of a VSD would save 23,600 kwh/pa. Ideally this VSD would be connected to a differential pressure sensor across the condenser which would then maintain a constant flow through the vessel regardless of what other pumps were running in the system. We suggest that this be undertaken at the time when the Luke chiller is replaced.

Comment [WUS]: 30% of 9.8kw = 3.0kw = 8760 x .9 x 3kw = 23,600kwh Draws (17amps)

3.2 Chilled Water Pump

The picture above shows that in order to balance the water flow though the powerpax chiller that the valve on the flow side of the chiller has been closed 50%. As with the condenser water system shutting the valves to balance the system creates additional system resistance which then requires more pump energy to overcome.

Installation of a variable speed drive on the chilled water pump would enable the flow valve to be opened

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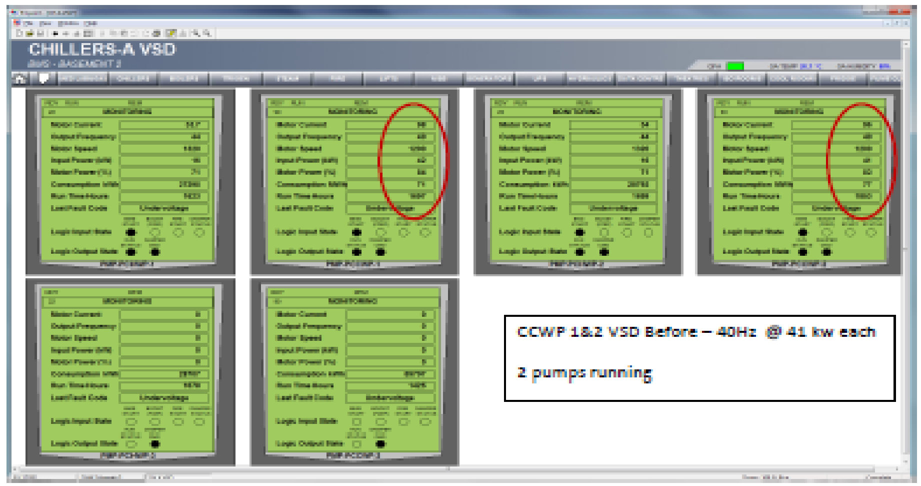
Practical Examples of Energy Efficiency

CCWP - flow balancing

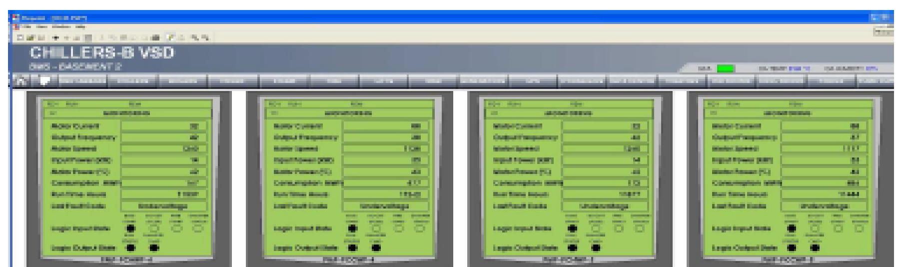
Conclusion

Based on the above data the payback for the implementation of condenser water pump speed control is 2.3 years



CCWP 1&2 VSD Before – 40Hz @ 41 kw each

2 pumps running



CCWP -3 VSD after – 37Hz @ 33 kw

CCWP -4 VSD after – 38Hz @ 35 kw

2 pump running

Resources


Heating
Ventilation &
Air-Conditioning
Automatic controls
CIBSE Comm
CIBSE
DETR
Building energy metering
CIBSE
MAIN INCO
DH SMALL POWER
TM39: 2009
DA
INDOOR AIR
DA2
BUILDING MANAGEM
AND CONTROL SYST
(BMCS)
APPLICATION MANUAL
AIRAH
THE AUSTRALIAN INSTITUTE OF REFRIGERATION, AIR CONDITIONING AND HEATING
DA27
BUILDING COMMISSIONING
APPLICATION MANUAL
AIRAH

Questions