BAKER STREET

55 Baker St. Chiller Efficiency Survey

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Executive Summary

1.1 The radical renovation of a 1950's office building transforms this site into an important new urban amenity. While providing a range of flexible and highly efficient office spaces, the scheme enhances activity at street level by offering a mix of uses and introducing a substantial new public space to the streetscape.

1.2 The Chiller plant identified in this report is fundimemtally used for cooling essential services including Server Suites, PBAX Crack Cupbpoards and Critcal Temperature Areas. This being the case, up to 4 off Aermec Chillers are available to run to maintain a Leaving Chilled Water (LCW) condition of 6.0 °C, 24 Hours a day, 365 Days a year.

1.3 As part of the general drive within the HVAC industry to reduce energy consumption and as part of Aermec's commitment to this, 55 Baker Street has been identified as a site where energy savings; primarily on the water chillers, could potentially be made. This report identifies energy savings specifically related to the Chiller's operation on this site only.

1.4 Emphasis is placed on energy savings that could be made without significant alterations to the Chillers and that do not fundamentally change the over-all HVAC system design. The chillers on site are highly efficient utilising Free Cooling when ambient temperature permits. This reports scope of works only covers the Essential Water Chillers, touching on the related primary chilled water hydraulic circuit serving these chillers.

1.5 The approach adopted in this report is to first make some initial comments on the general mechanical and electrical condition of the chiller plant, then analyse the performance of the main chiller components via data logging. Using the data captured we can build an energy footprint and present 'Actual Site Condition Performance' and guide the end user into small changes that can make large Running Cost Savings with minimal expense.

CONTENTS

General Conditional Survey

The chillers on site have been maintained by the UK manufacturer. On the day of the survey there were a few issues that should be addressed on the next round of preventative planned maintenance, these include:

- Schrader Valve caps having missing or perished rubber seals.
- Some controllers have been upgraded from the Carel Pco2 to the Pco3 controllers.
- System No1 has oil residue around sight glass.

Energy Efficiency equipment already installed on the Chiller.

Essential Chiller No2

This chiller has been loaded with a full array of Energy Saving Equipment and features, these include :

- Electronic Expansion Valve – This operates at a much lower pressure differential than a mechanical valve so allowing a lower Condensing Saturated Refrigerant Temperature °Csat
- Condenser Fan Speed Control – This evenly distributes the Temperature Difference (TD) between saturated refrigerant temperature Condenser °Csat and Ambient Cooling Air. Also matches required airflow to Condensing Temperature (Cond °Csat) Setpoint though Stepless motor speed control.
- Screw Compressor has a minimum turn-down of 20% with stepless capacity control to 100%. This equates 25 kW minimum duty up to 126 kW per compressor.
- Free Cooling via double section condenser coils with run-around integral pump. Highly efficient, when ambient is lower than 1.0 °C compared to the Return Water Temperature this circuit is enabled. A harvest of a mixed E.E.R rating up to the Full Free Cooling Output at an ambient of 0.0 °C where the E.E.R goes to the full 14.2 W/W

Chilled Water Hydraulic System

The Chilled Water Hydraulic System utilizes VSD Speed Control on the Chilled Water Pump motors and 2 port valves on the chillers required to run. This concept is the most cost effective way to control multiple chillers in a parallel configuration as seen on site. There are no additional power savings to be had from this hydraulic circuit.

ESSENTIAL CHILLER 2 SELECTION DATA

CHILLER SELECTION DATA

MECHANICAL COOLING

Chiller Duty 253.7 kW Ref.

Chiller Input Power 96.6 kW Abs.

E.E.R 2.63 W/W

Design Ambient 32.0 °C DB

Chilled Water Flow Rate 10.9 L/S

6.0 °C in – 12 °C out Temps.

FREE COOLING

Duty 170.5 kW Ref.

Input Power 12.0 kW Abs.

E.E.R 14.2 W/W

Design Ambient 0.0 °C DB

Chilled Water Flow Rate 8.5 L/S

4.25 °C in – 9.0 °C out Temps.

ESSENTIAL CHILLER 2

MODEL:

NSB 1042 EF

SERIAL:

07036681150001

Data Logging - The Results

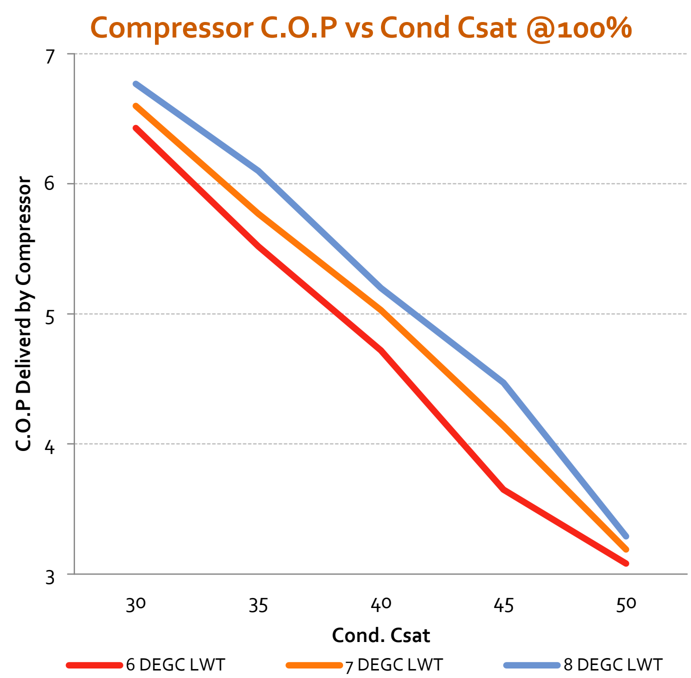
We utilise a 16 Chanel Multi Function Input and a 8 Chanel K-Type Thermocouple 20 Bit Resolution data loggers to capture the running telemetry of each system. The primary data points we capture include:

- True Absorbed Power
- CW Water Flow Rate
- Suction & Discharge Pressures, T Sat temperatures & Line Temperatures
- Chilled water Flow & Return Temperatures.

Almost instantly it became apparent that there was minimum scope to offer power savings on the chiller to be logged, it wasn't until we fitted the Data Logger we could see an inefficiency which can be easily addressed.

Power Savings to be realized through lowering Cond °Csat.

The main component on the system with any scope of power savings was the Screw Compressors. We logged the compressor with the various Chilled Water leaving Conditions, at various Condensing °Csat conditions at 20% and 100% Loading to realize a Compressor C.O.P Saving; as represented on the adjacent graph.



It became apparent that the Condenser °Csat Setpoint was around 50 °C; approximately 12.1 BarG. By a simple Setpoint adjustment to 35 °Csat we can deliver an almost 80% increase in C.O.P; Increasing from 3.08 to 5.53 @ 6.0 °C @ 100% loading.

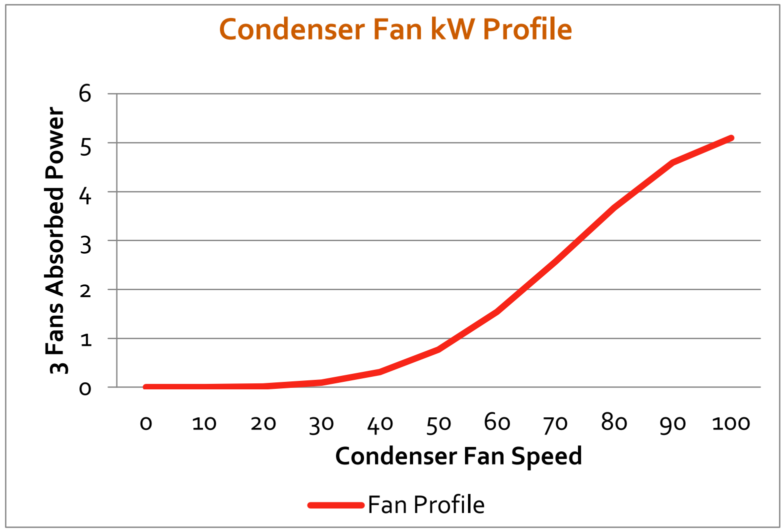
There will be an increase in Condenser Fan Absorbed Power due to the additional requirement of air being drawn through the condensers heat exchanger.

The table below represents the relationships between Saturated Condensing Temperature (°Csat) and Chilled Water Temperature (°C) and the relationship they have on compressor C.O.P

COND °Csat	CW @ 6.0 °C	CW @ 7.0 °C	CW @ 8.0 °C
30 °Csat	6.43	6.6	6.77
35 °Csat	5.52	5.77	6.1
40 °Csat	4.72	5.03	5.2
45 °Csat	3.65	4.14	4.47
50 °Csat	3.08	3.19	3.29

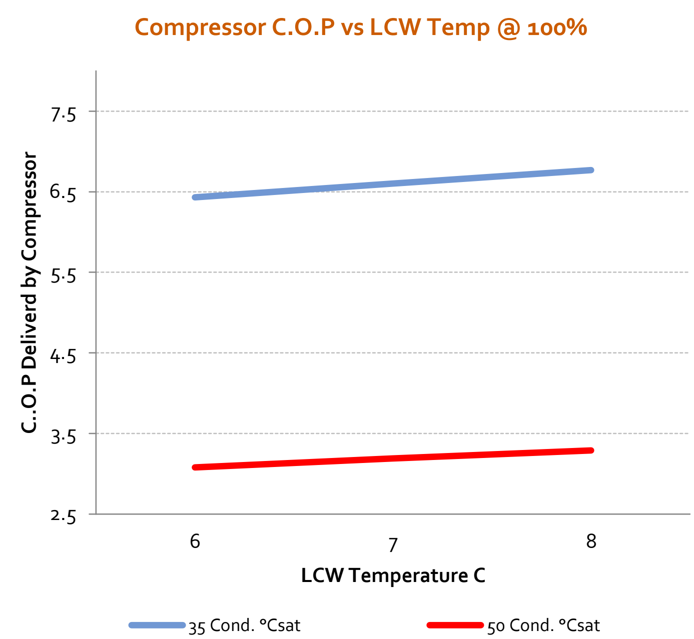
Power Losses - Speeding Condenser Fans up for Lower Cond °Csat.

There is an energy cost to lowering the Condenser °Csat Temperature; the additional fan power required to move additional ambient air through the Finned Condenser Heat Exchanger. We captured the energy requirements of the 3 off condenser fans on each system at various speeds, as plotted adjacent. Even taking the worst case that that the fans will run at 100% to maintain the lower Cond °Csat requirement, we have calculated a loss of 7% on the C.O.P savings we have quantified. i.e. At 6.0 °C LCW @ 35 Cond °Csat from 50 Cond °Csat, we gain 2.45 C.O.P on the Compressor. The Condenser Fan Energy Cost is 7% of the 2.47 which is 0.17 on C.O.P giving an overall Compressor & Condenser Fan C.O.P of 5.36 @ 100% loading.



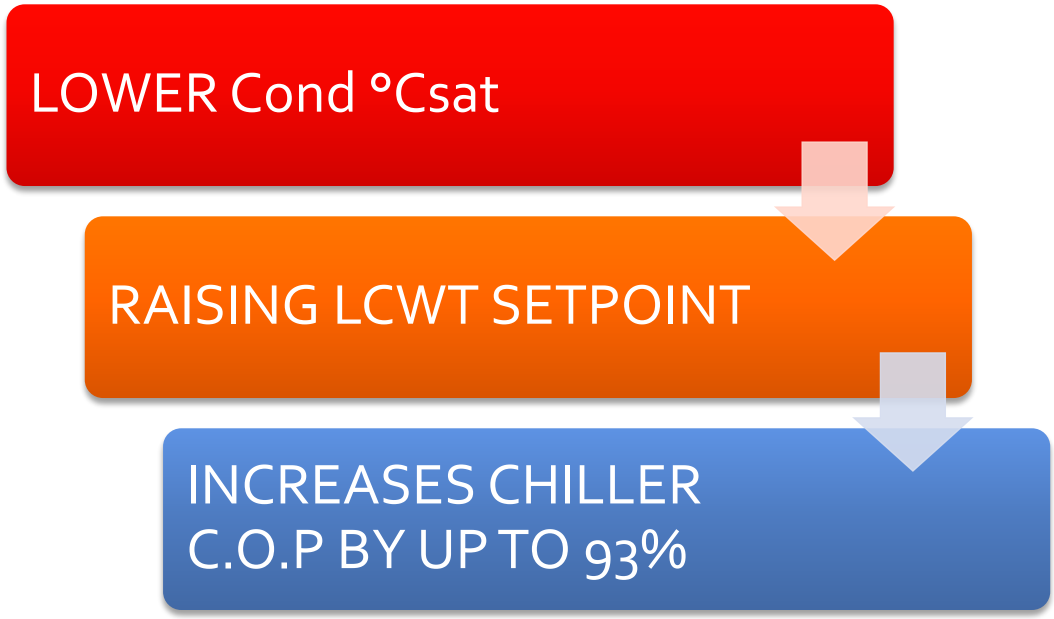
Power Savings to be realized through raising Chilled Water Setpoint.

A further C.O.P increase can be realized by raising the Chilled Water Temperature from 6.0 °C to 8.0 °C. This delivers an increase of around 10.5%; from 5.52 to 6.1 @ 100% loading. (Using the table of data on Page 5)



Conclusions

We have clearly demonstrated that a small operational Condensing °Csat setpoint change will have a dramatic effect on energy consumption, coupled with additional gains if the Chilled Water Setpoint rises to 8.0 °C.



The above can be quantified by referencing the Data Table on Page 5 and the comparitive statements below.

FINAL NUMBERS FOR CONSIDERATION

CURRENT CHILLER SETUP	CHANGE TO COND °CSAT	CHANGE TO COND °CSAT + LCW
C.O.P = 3.08	C.O.P with fan Energy Cost = 5.34	C.O.P with Fan Energy Cost = 5.94
	Increase in overall C.O.P of 74%	Increase in overall C.O.P of 93%

The findings and information detailed in this report are presented without prejudice.