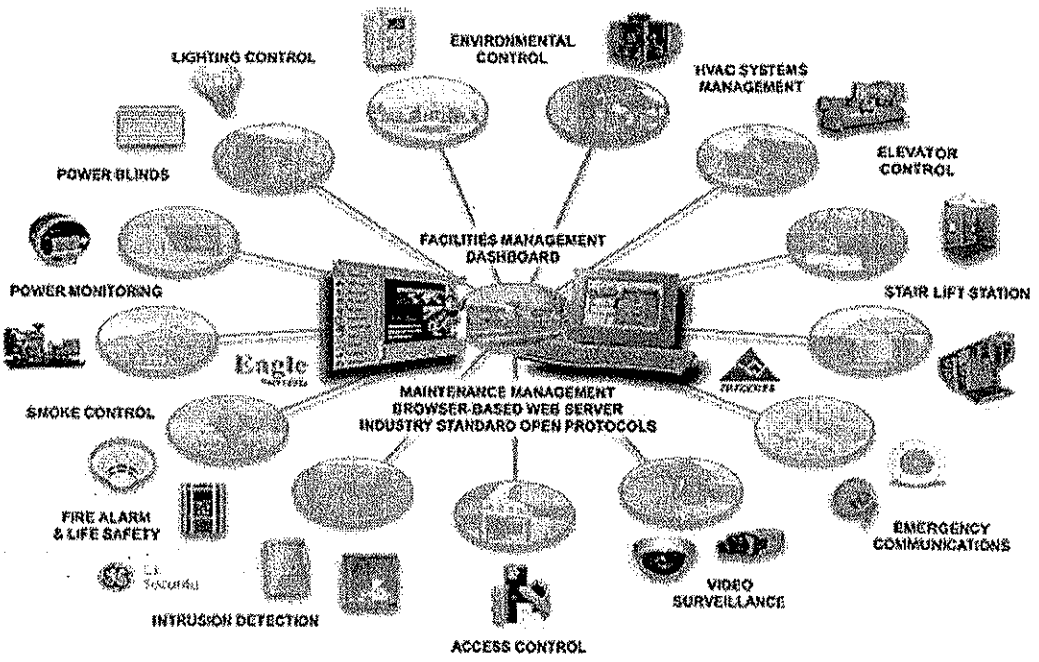
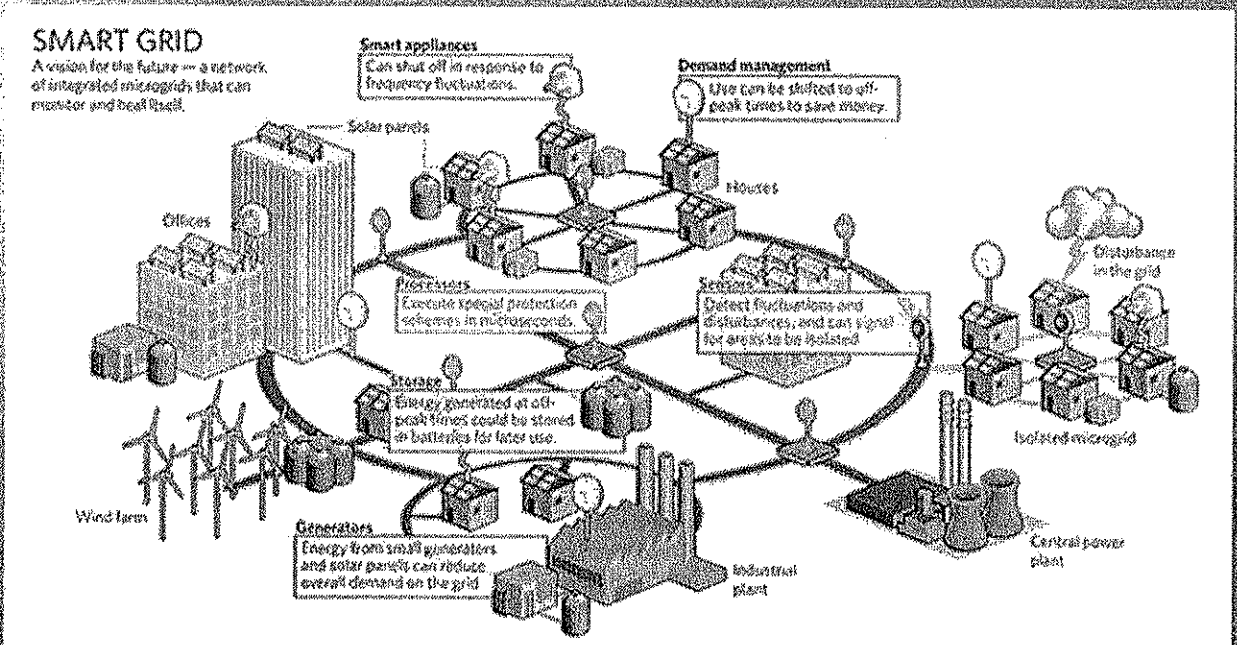
Typical functions of BAS

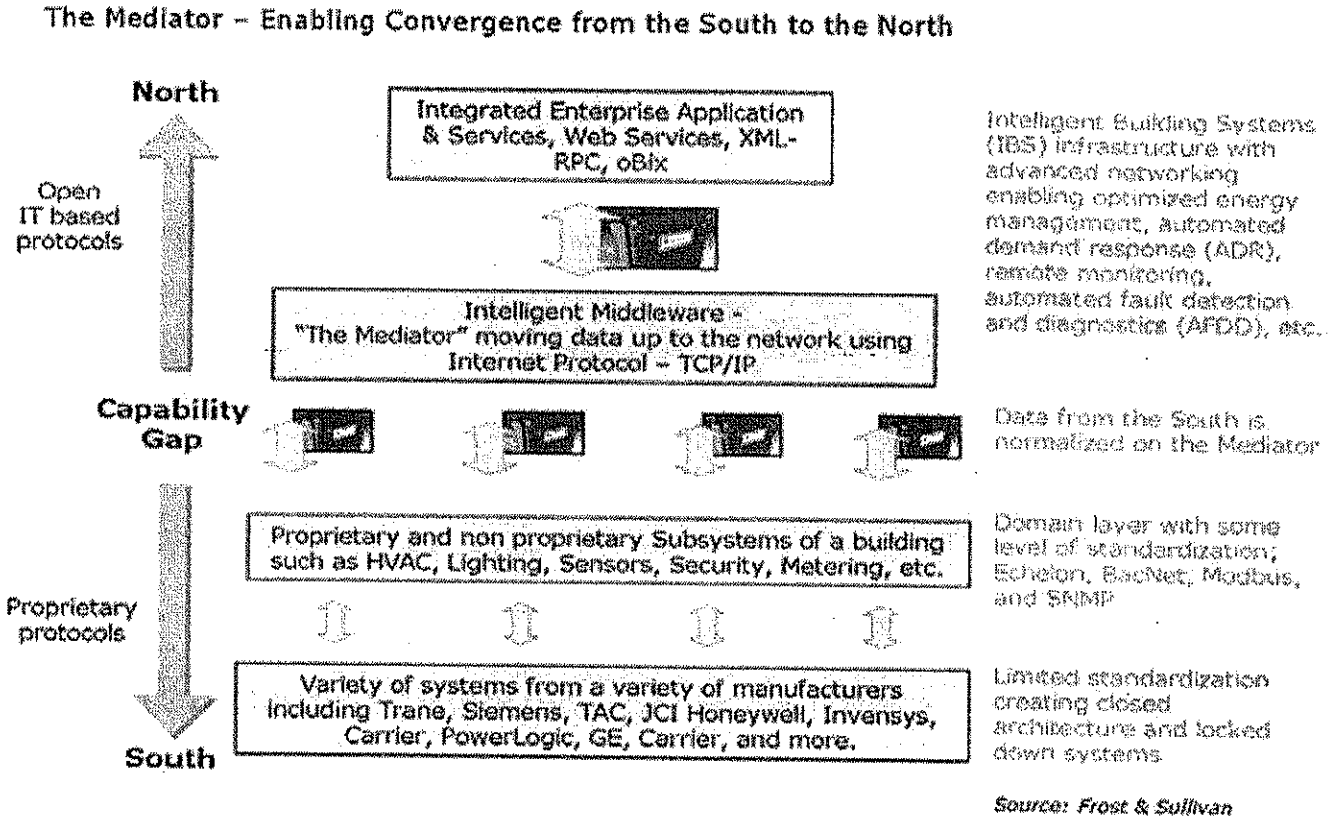


Control & monitor all systems in the building

Building Automation gets Griddy while colliding with the corporate Enterprise



Higher Level Integration



Source: Frost & Sullivan

USENERGYGROUP
SYSTEMS • MONITORING • ANALYSIS

Building Efficiency Through Information Management℠

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USE Manager

Products Overview | USE Manager | USE Controller | USE Verifier | USE Mobile

USE Mobile is a web-based application designed for the iPhone that allows building managers and owners with a USE Controller EMS to access heating system information in real-time for their buildings.

USE Mobile gives the user the ability to:

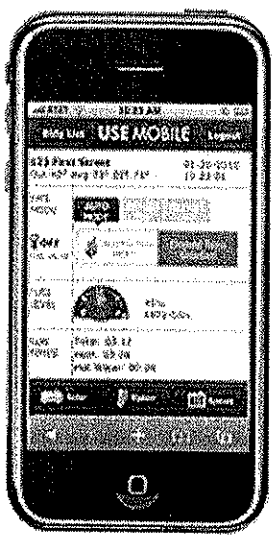
View Boiler Status – Current fuel valve and EMS status, oil tank level, and runtime for the day.

View System Status – Current aquastat, coil, domestic hot water, and stack temperatures, as well has highs and lows for the day and water loss.

View Space Temperatures – View individual unit temperatures in real-time to verify heat complaints.

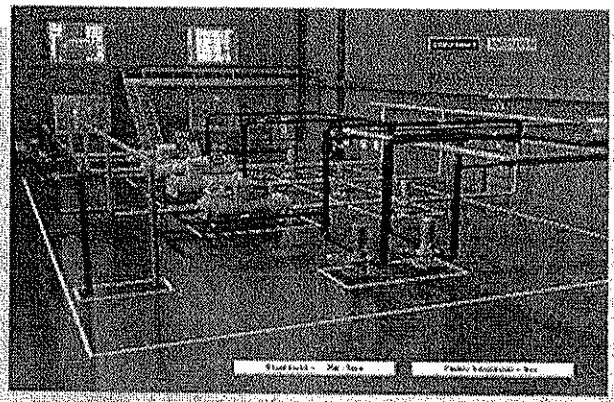
Remotely Bypass the EMS – Manually turn the heat on or off from your iPhone when needed.

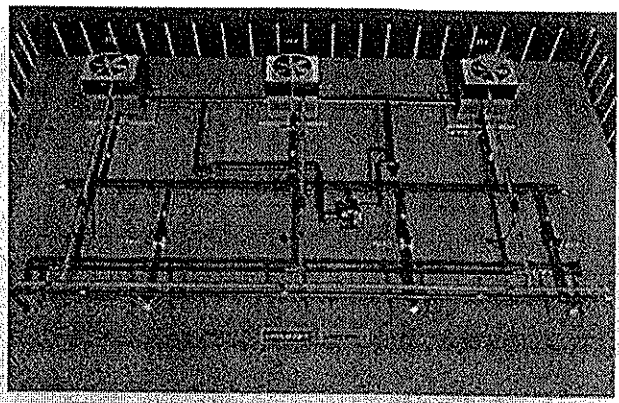
USE Mobile is available for free to all USE Manager customers. Simply visit www.use-manager.com from your iPhone and log in with the same username and password you use to access USE Manager. Save the application to your home screen for quick access later.

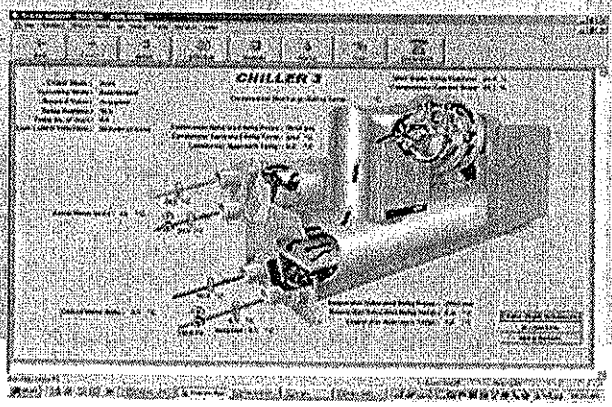


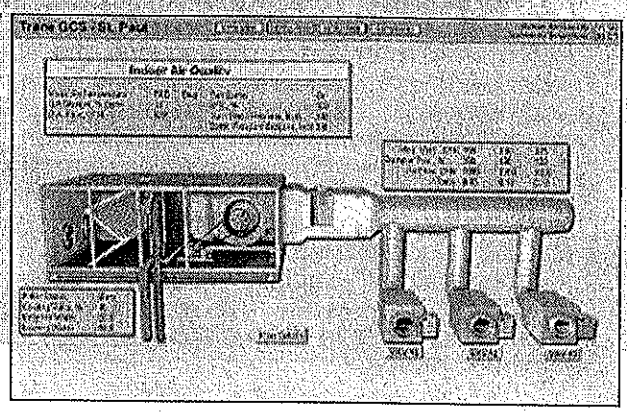
© 2009 US Energy Group, LLC.

Workstation Graphics



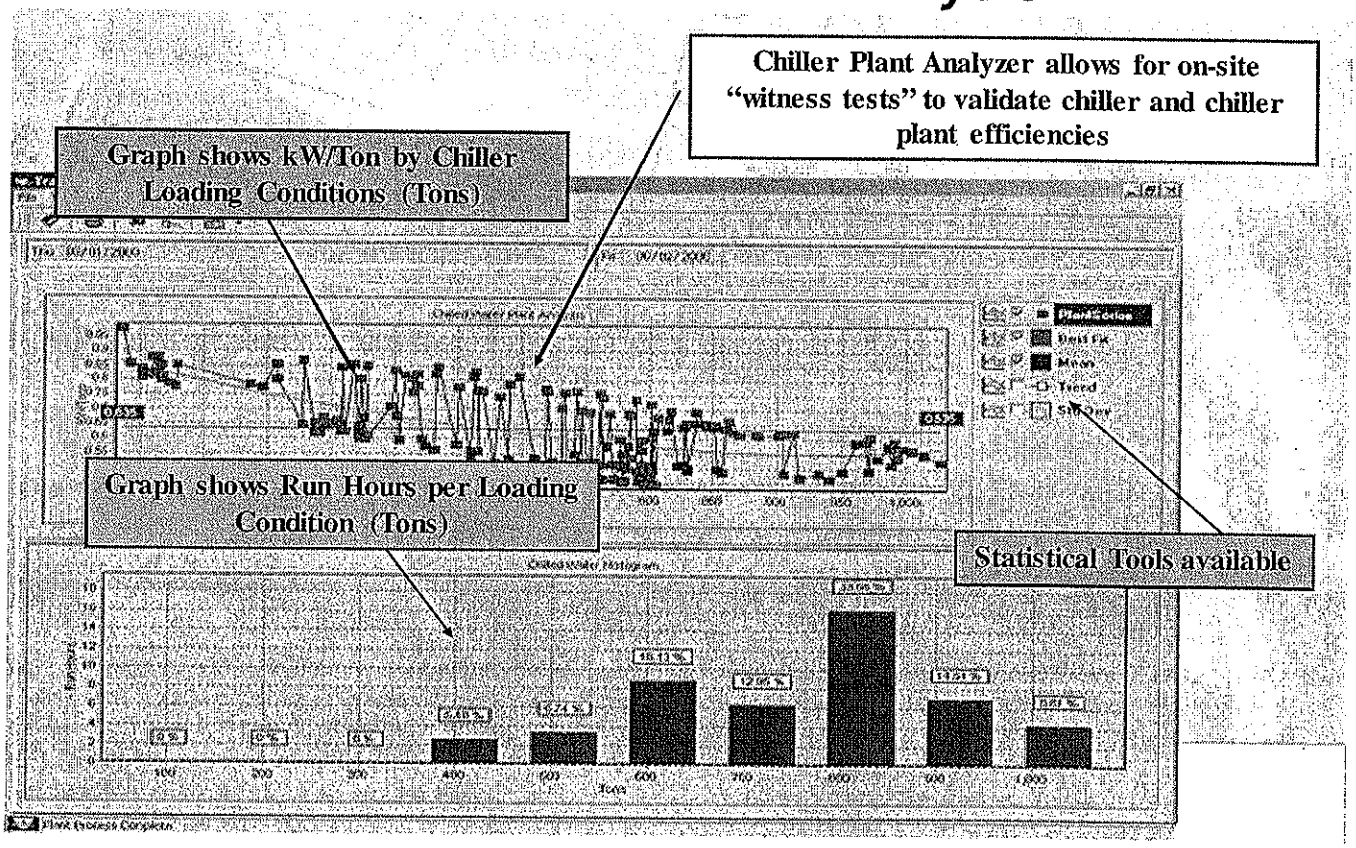






Energy Monitoring & Reports

Plant & Chiller Performance Analysis



Issues with existing BAS

- **NARRATIVE SUMMARY OF PROPOSED PROJECT**
- Contractor: Pacific Gas and Electric Co.
- Contractor's Project Manager: Steven L. Blanc
- Commission's Project Manger:
- Term of Project: 1 year
- **PURPOSE:**
- Based on our own and others research, we have determined that ***the present state of building controls technology is inadequate to support the used of advanced control methods to save energy. The fragmented state of the industry and an incomplete understanding of the technical issues surrounding controls has led to mediocre design and under use of control systems presently in the building stock of California. A major area where we see potential for improvement on a wide scale involves data acquisition and monitoring.*** This project will investigate the solutions to the data acquisition and monitoring challenges faced in using energy management systems for advanced control, performance monitoring, diagnostics and commissioning. The work falls into two phases: first, understanding the type and frequency of data needed to establish a viable database for the aforementioned services and second, investigating the type and accuracy of sensors actually needed for control system data acquisition. This work would support future phases investigating lower cost sensors for monitoring, measuring and data acquisition, and the needs for data acquisition facilities within the control systems themselves. The present request would cover the first tasks: understanding and documenting the type and frequency of data needed to establish a viable database for advanced control, performance monitoring, diagnostics and commissioning, then investigating the best combination of type and accuracy of sensors to support these services. This work is the necessary cornerstone to pursue fruitful research in this area and to give the controls industry further impetus to reach any significant energy efficiency gains.

Latest NEA guidelines for energy audits in Singapore—June 2009

- Chilled water plant system performance
- System performance measurement error shall not exceed **±5%.** *This implies the use of high accuracy thermometry and calorimetry.*
- Detailed method statement explaining how the required degree of accuracy was achieved with the instruments and data acquisition hardware employed.
- Data required to establish system performance must be sampled and acquired simultaneously and continuously for a minimum of 1 week at one-minute intervals.
- Energy efficiency of major equipment compared against industrial benchmarks
- Measurement and verification (M&V) plan for monitoring and verifying energy savings for each of the recommendations
- CD-ROM containing the raw measurement data

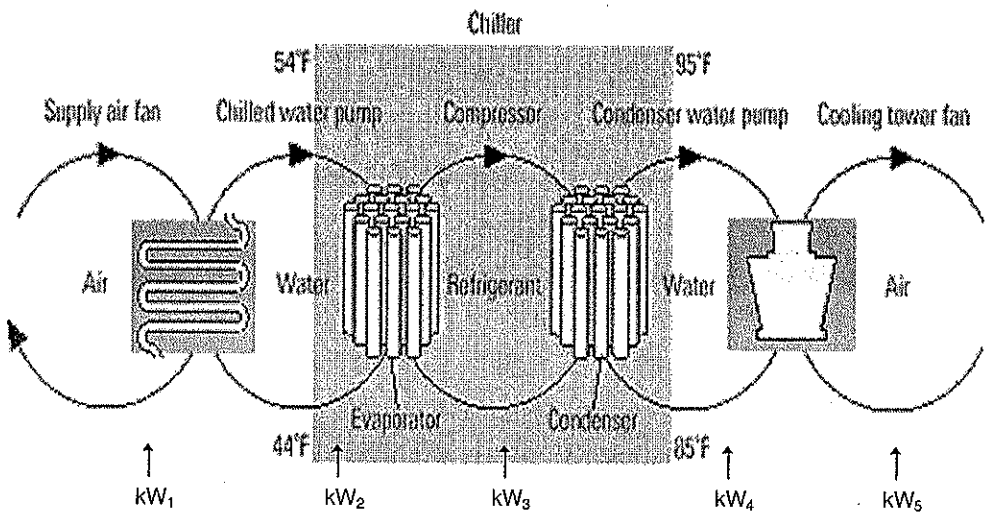
Making Energy Efficiency Accountable

Right now there is no off-the-shelf delivery process in place to develop truly effective energy efficiency improvements with long term performance assurance.

Thomas Hartman, P E
The Hartman Company
June 2007,
automatedbuildings.com

The 5 Circle Diagram for HVAC

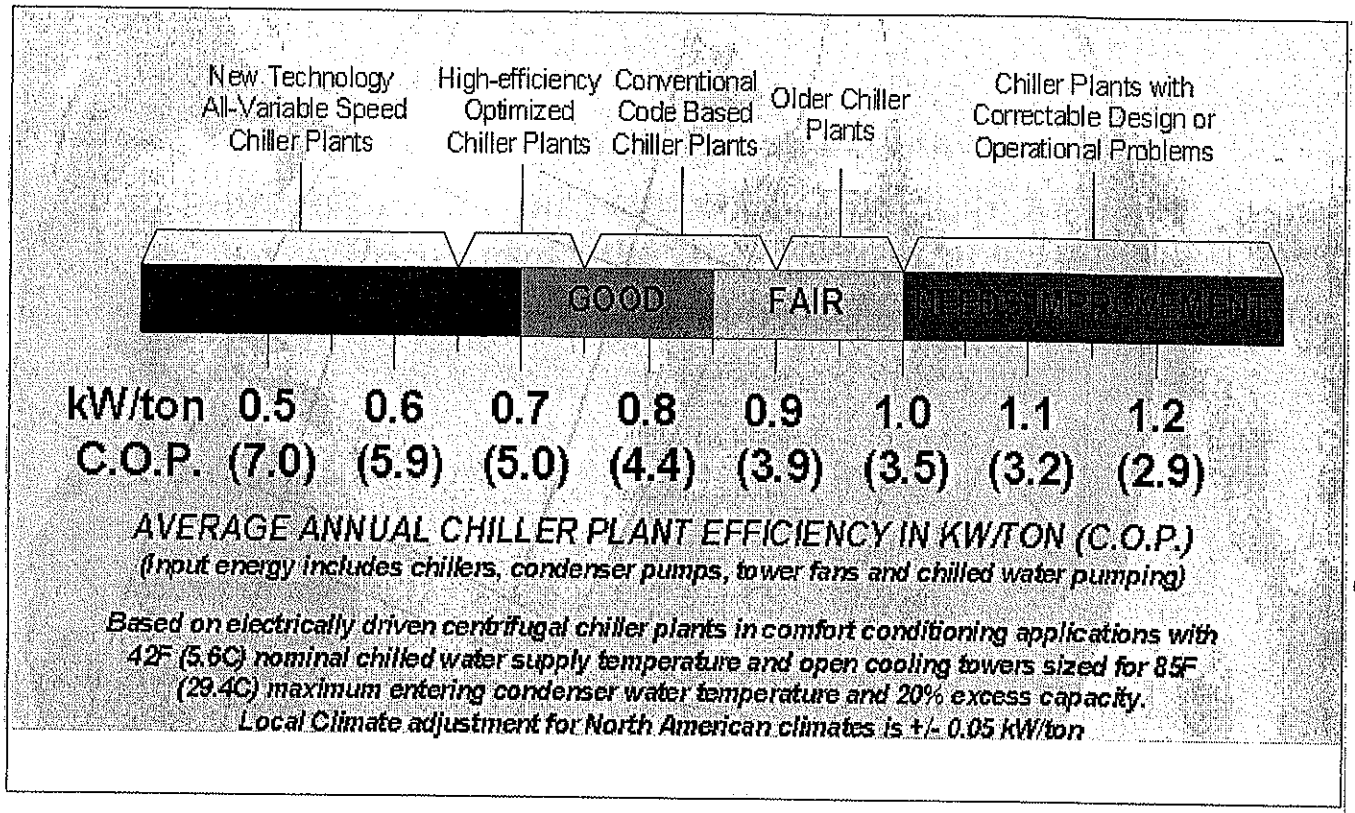
Total System HVAC Approach



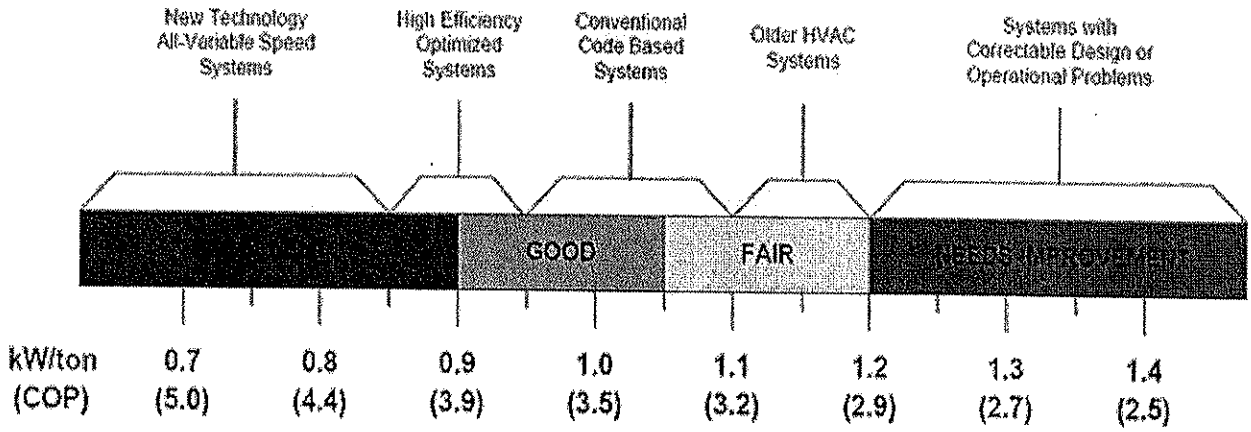
Cooling System kW/Ton $= \frac{kW_1 + kW_2 + kW_2 + kW_4 + kW_5}{Ton}$

Parasitic Load to Chiller $= kW_1 + kW_2$ ±10%

Ashrae--Chiller Plant Efficiency



Air + Water Side System kW/Ton

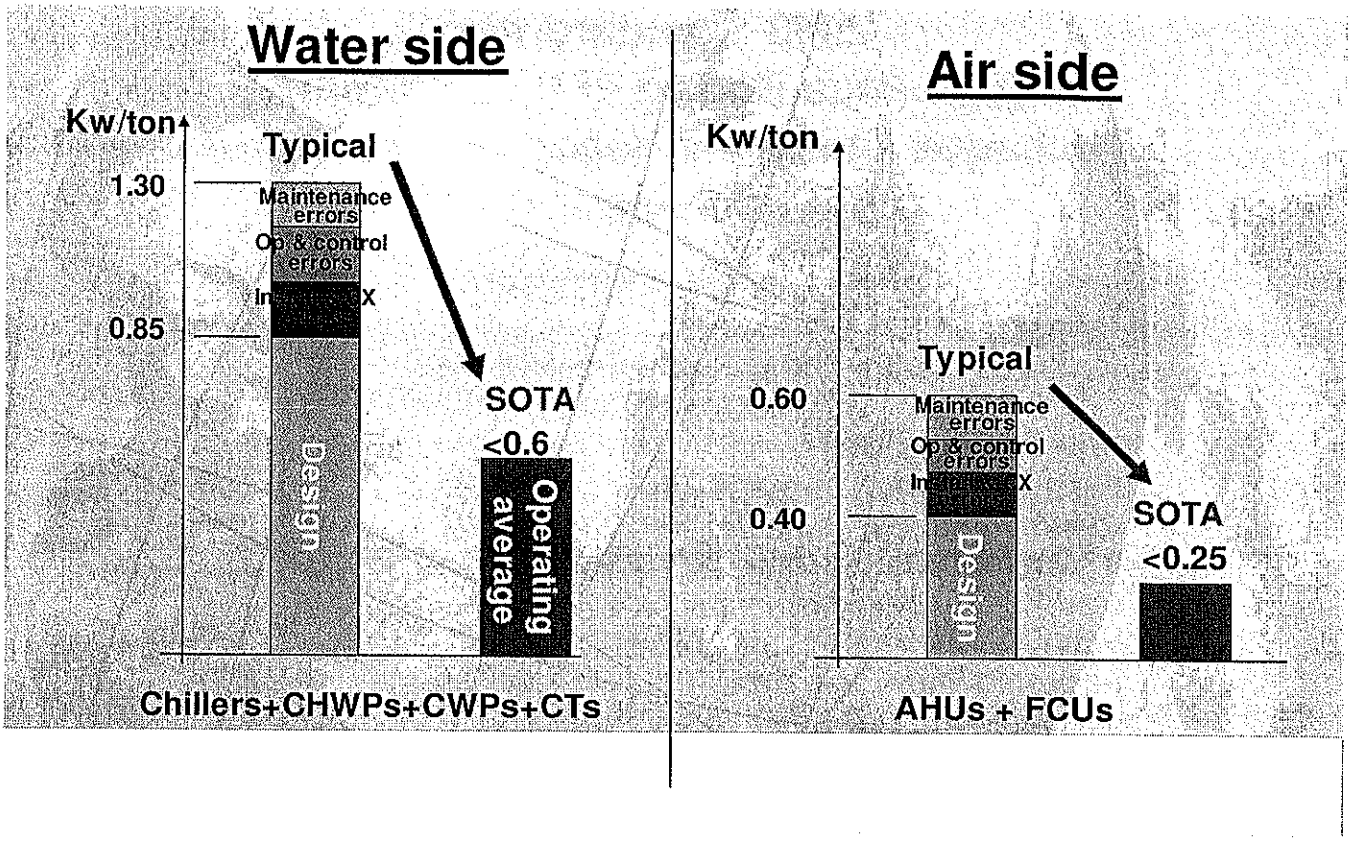


AVERAGE ANNUAL HVAC EFFICIENCY IN KW/TON
(Input energy includes all chillers, chilled water pumps, condenser water pumps, cooling tower fans, supply and return air-handler fans, and exhaust fans)

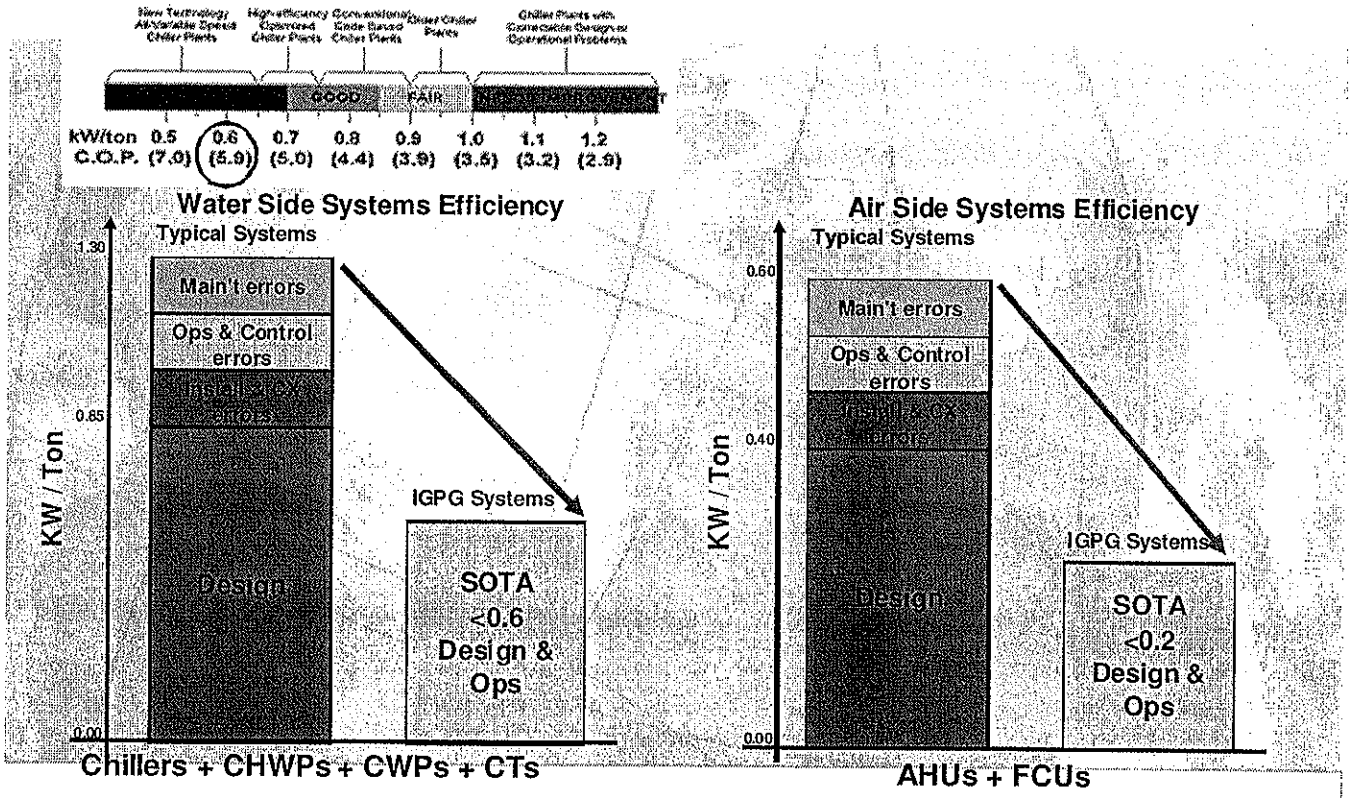
Based on electrically driven centrifugal chillers in comfort cooling applications with 42F nominal chilled water supply temperature and open cooling towers sized for 85F maximum entering condenser water temperature.

Figure 2: Total HVAC Energy Use Spectrum.

Typical vs State of the Art
air conditioning system average energy consumption



Typical vs State of the Art (SOTA)
air conditioning system average energy consumption



ARI Standard 550/590

2003 Standard for Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle

Standard 550/590

Certified Ratings:
The Certification Program ratings verified by test are:

1.) Capacity, tons [kW]
2.) Energy Efficiency, as applicable:-
- Power Input per Capacity, kW/Ton [kW/kW]
- Energy Efficiency Ratio (EER), Btu/(W-h)
- Coefficient of Performance (COP), watts/watt [W/W]

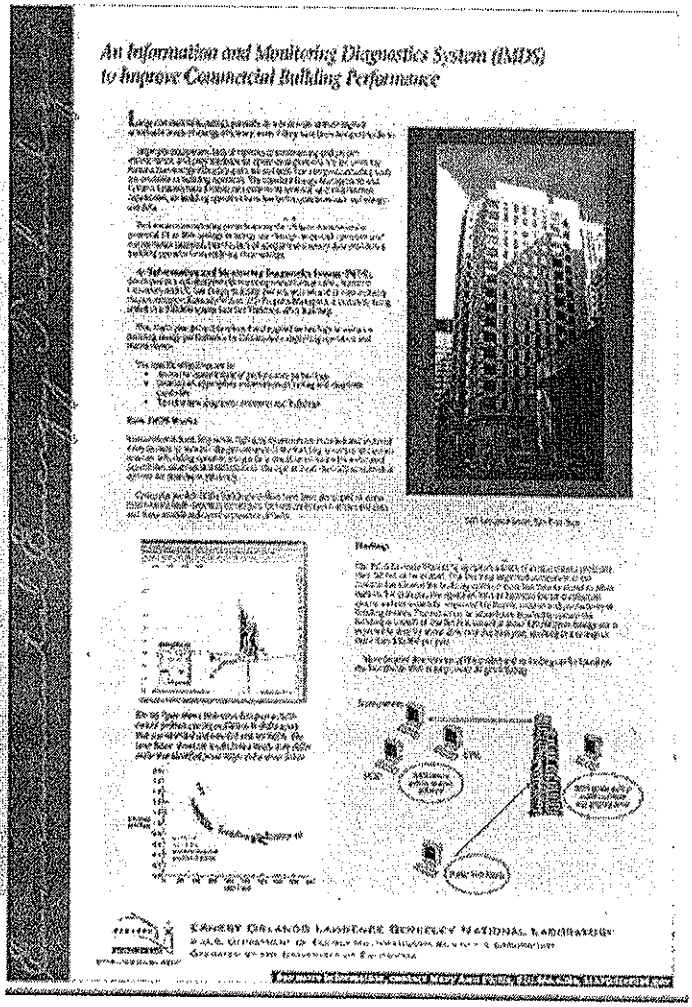
3.) Water Pressure Drop, psi or ft H_2O
4.) Integrated Part-Load Value (IPLV)
5.) Non-Standard Part-Load Value (NPLV)

AIR-CONDITIONING & REFRIGERATION INSTITUTE

Reference: ARI Standard

LBNL Research

- There has been work over decades to increase building efficiency
- The high accuracy and one minute monitoring and data analysis has been tested in california with favorable results



International Performance Measurement & Verification Protocol

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Sathaye, Jayant (co-chair), Lawrence Berkeley National Laboratory
Vine, Edward (co-chair), Lawrence Berkeley National Laboratory

Abaza, Lilian PEER Consultants
Berry-Lewis, Sylvia Honeywell
Bowie, Randall European Commission, Belgium
Cooley, Cris Syscomm
Cowan, John Cowan Quality Buildings, Canada
Datta Rav, G.C. DCM Shriram Consolidated Ltd., India
Jim Davis, Johnson Controls
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Dutt, Gautam University of Buenos Aires, Argentina
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Halpern, Jim, Measuring & Monitoring Services Inc.
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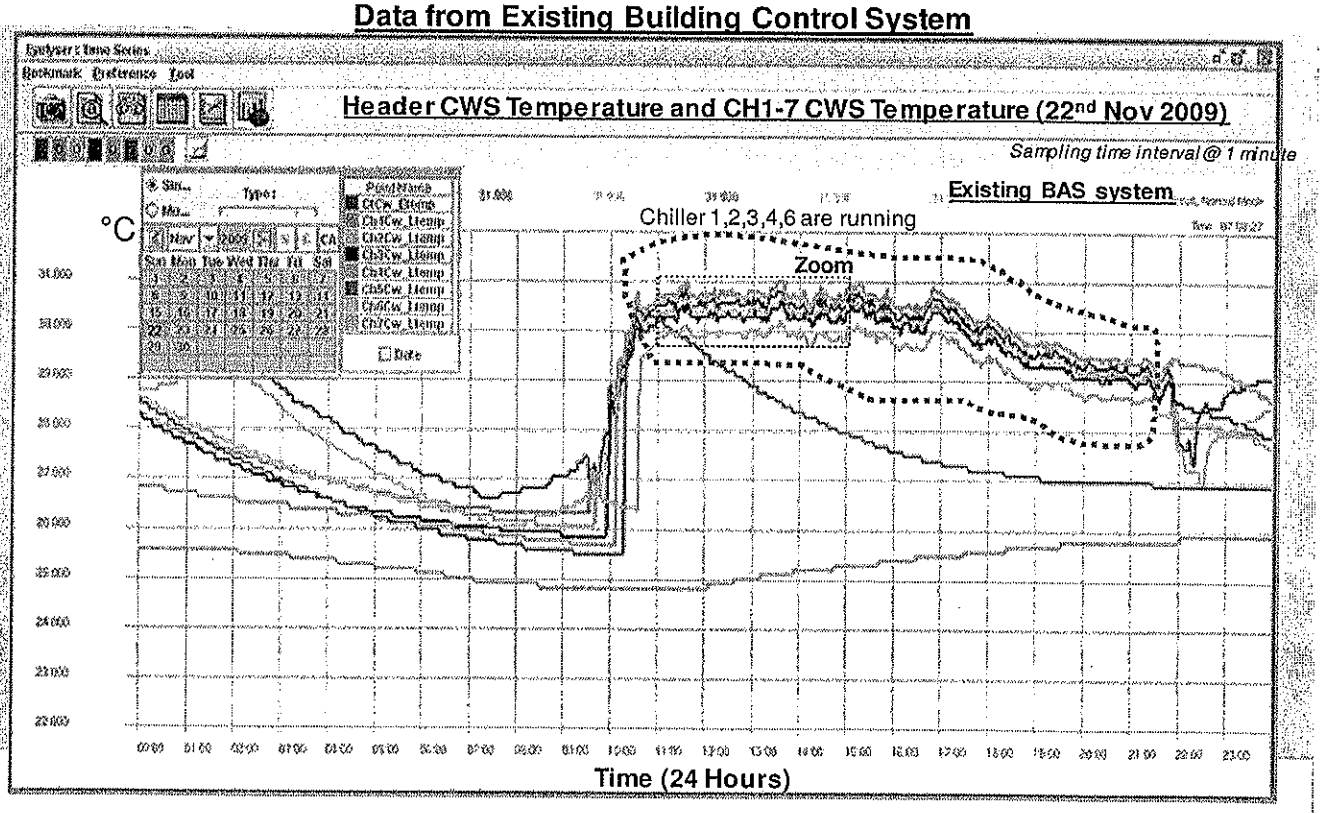
Raptsun, Mykola, ARENA-ECO, Ukraine
Robledo, Carmenza, Swiss Federal Laboratories for Materials Testing and Research, Switzerland
Rose, Robert U.S. Environmental Protection Agency

BAS and EMS

Data from Existing Building Control System



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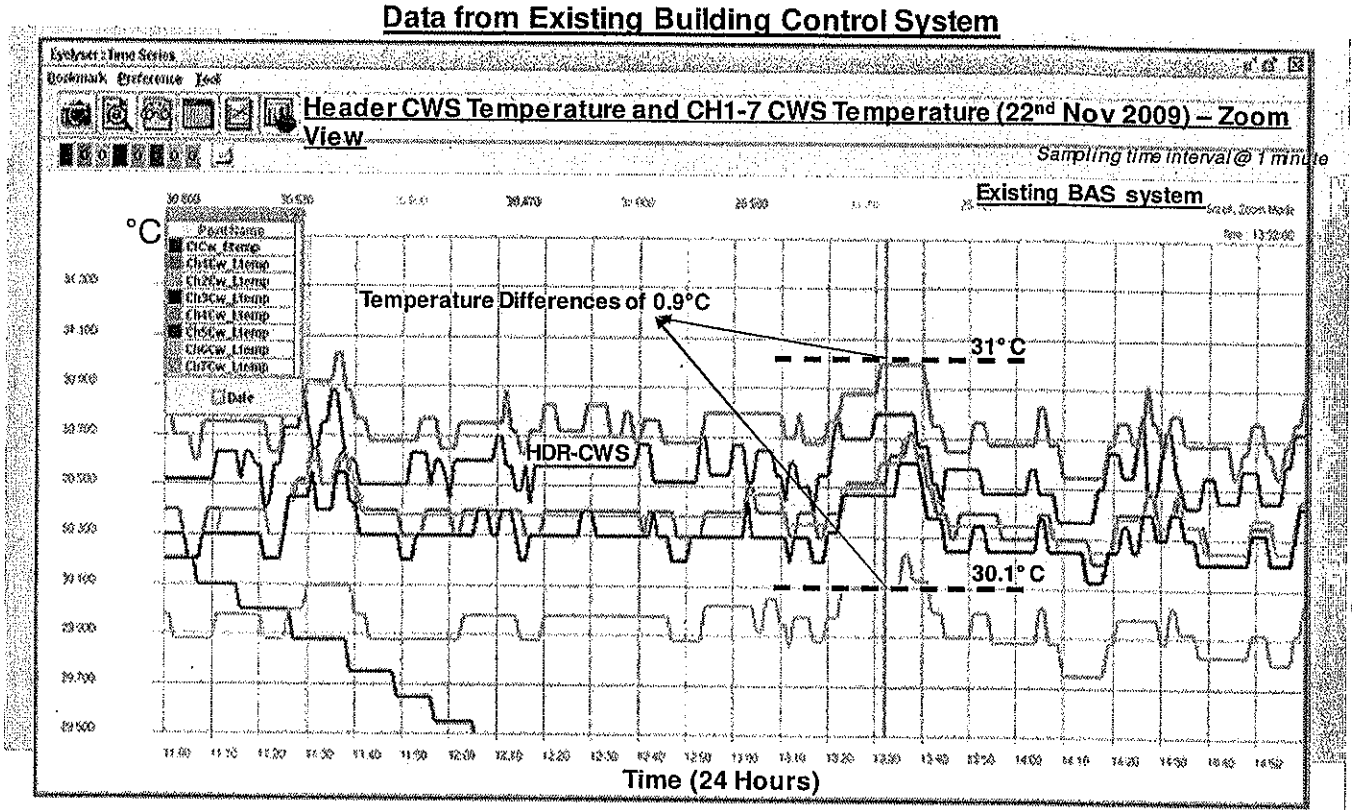

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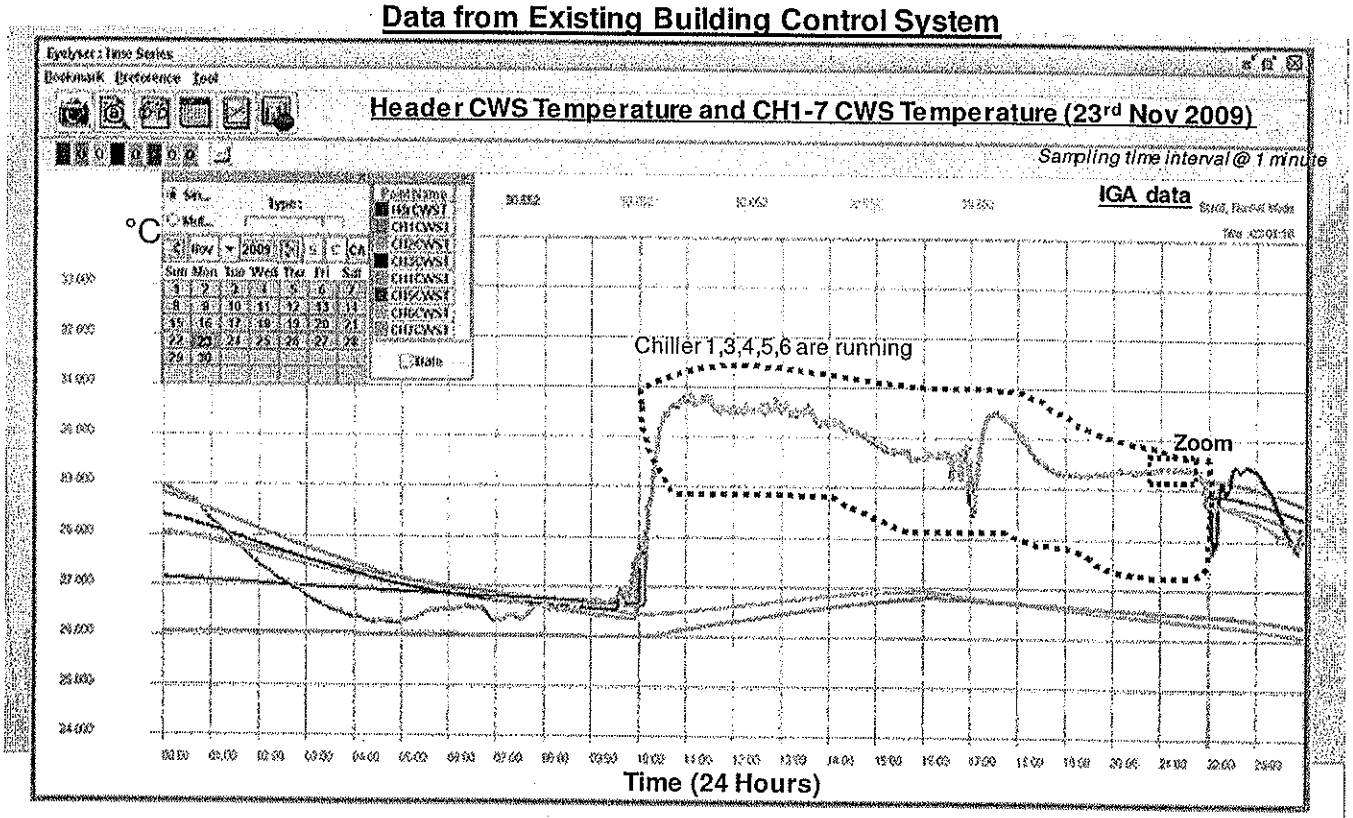

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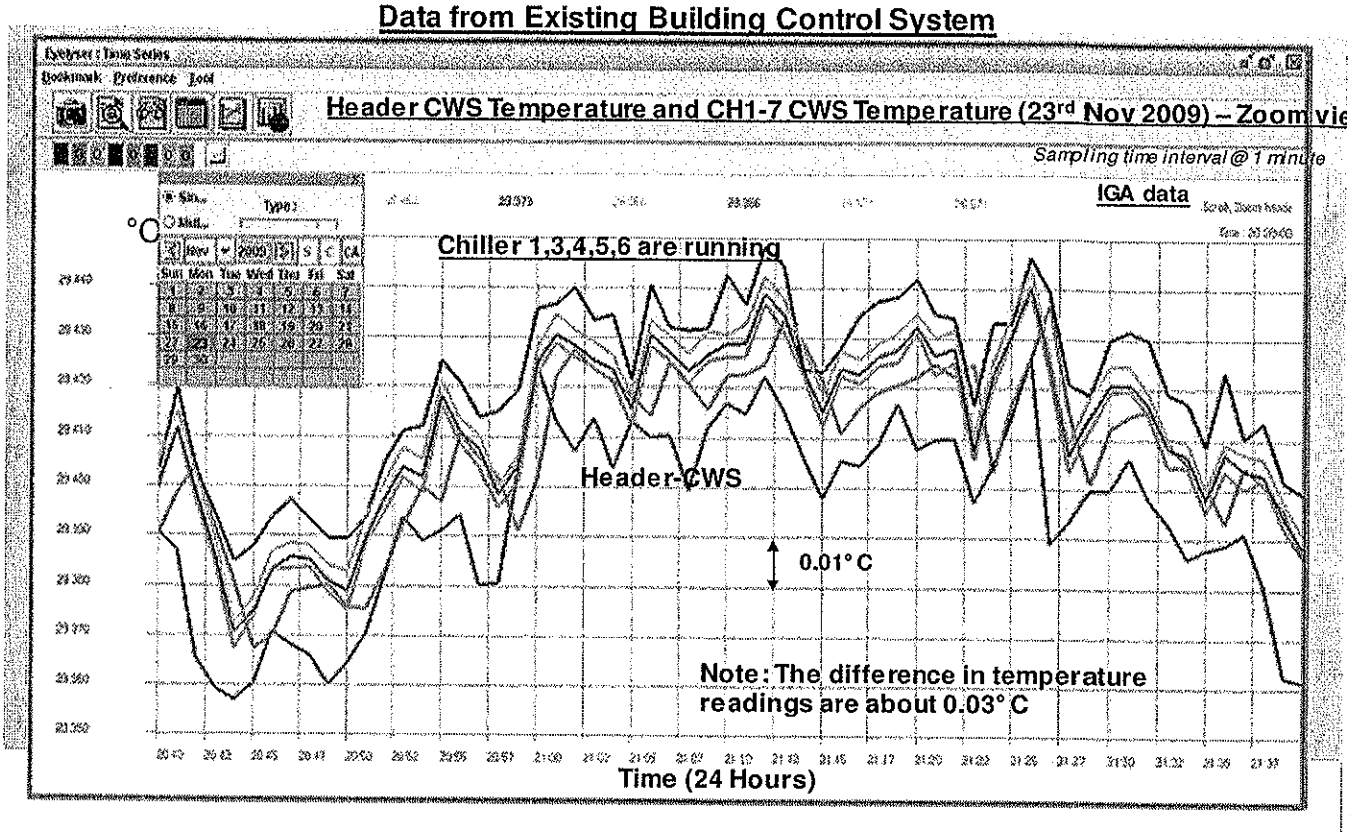

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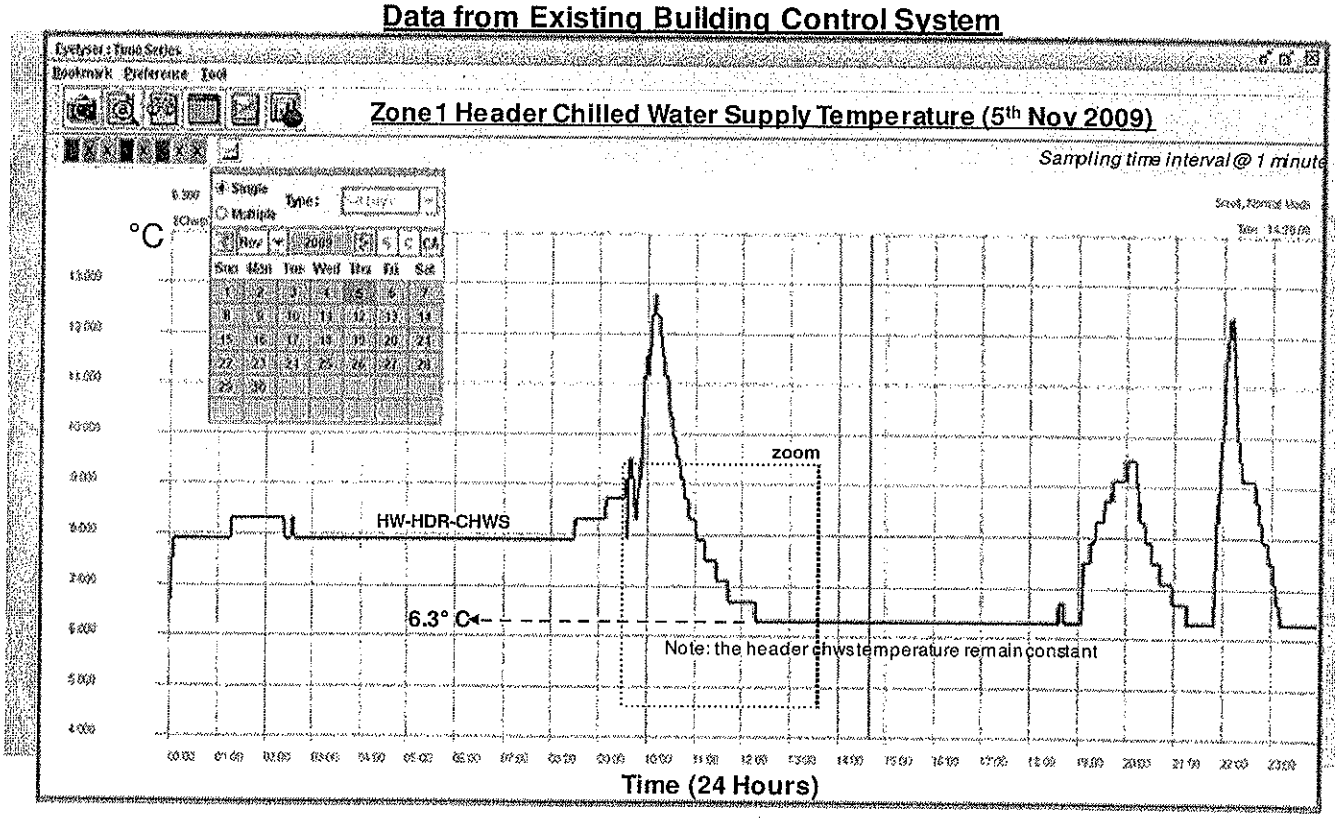
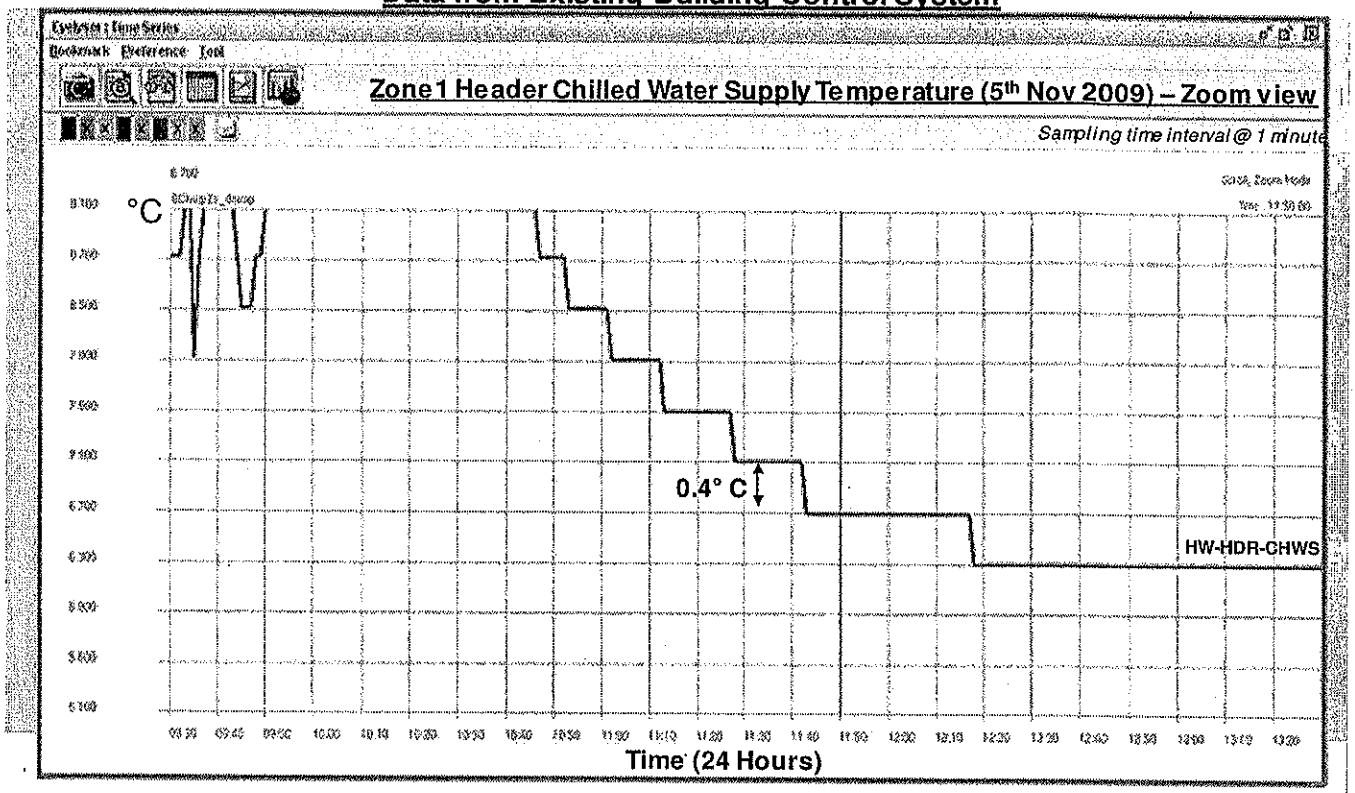


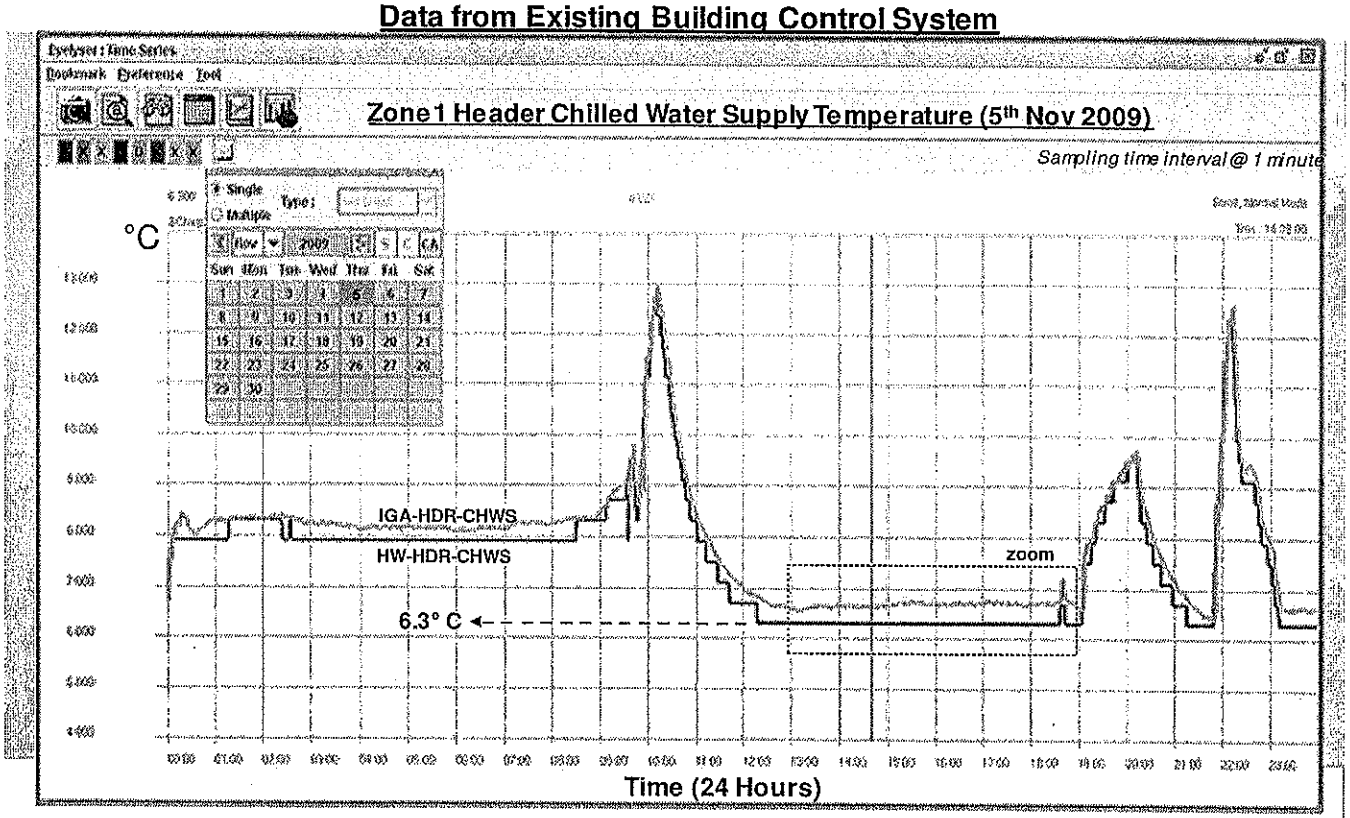
BAS and EMS

Data from Existing Building Control System



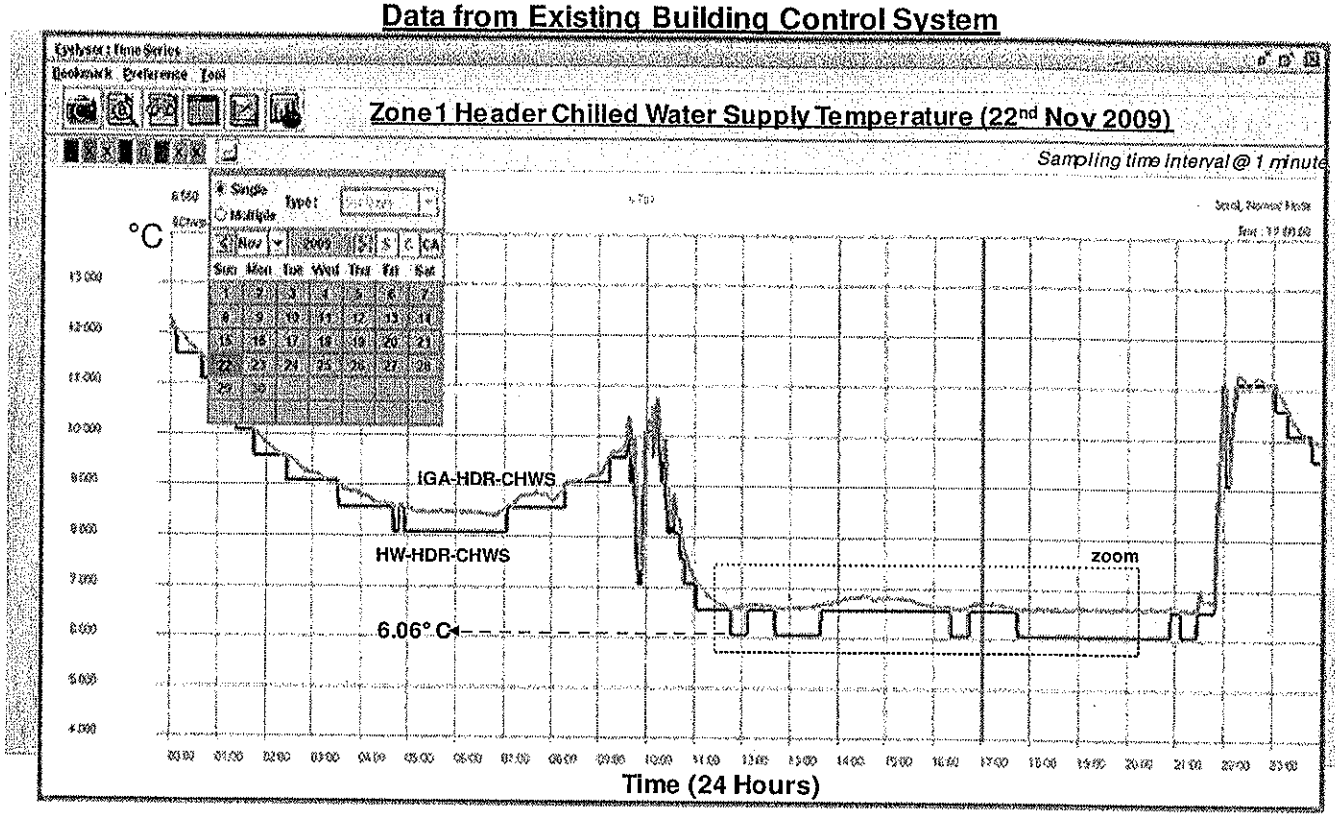
BAS and EMS

Data from Existing Building Control System



BAS and EMS

Data from Existing Building Control System



BAS and EMS

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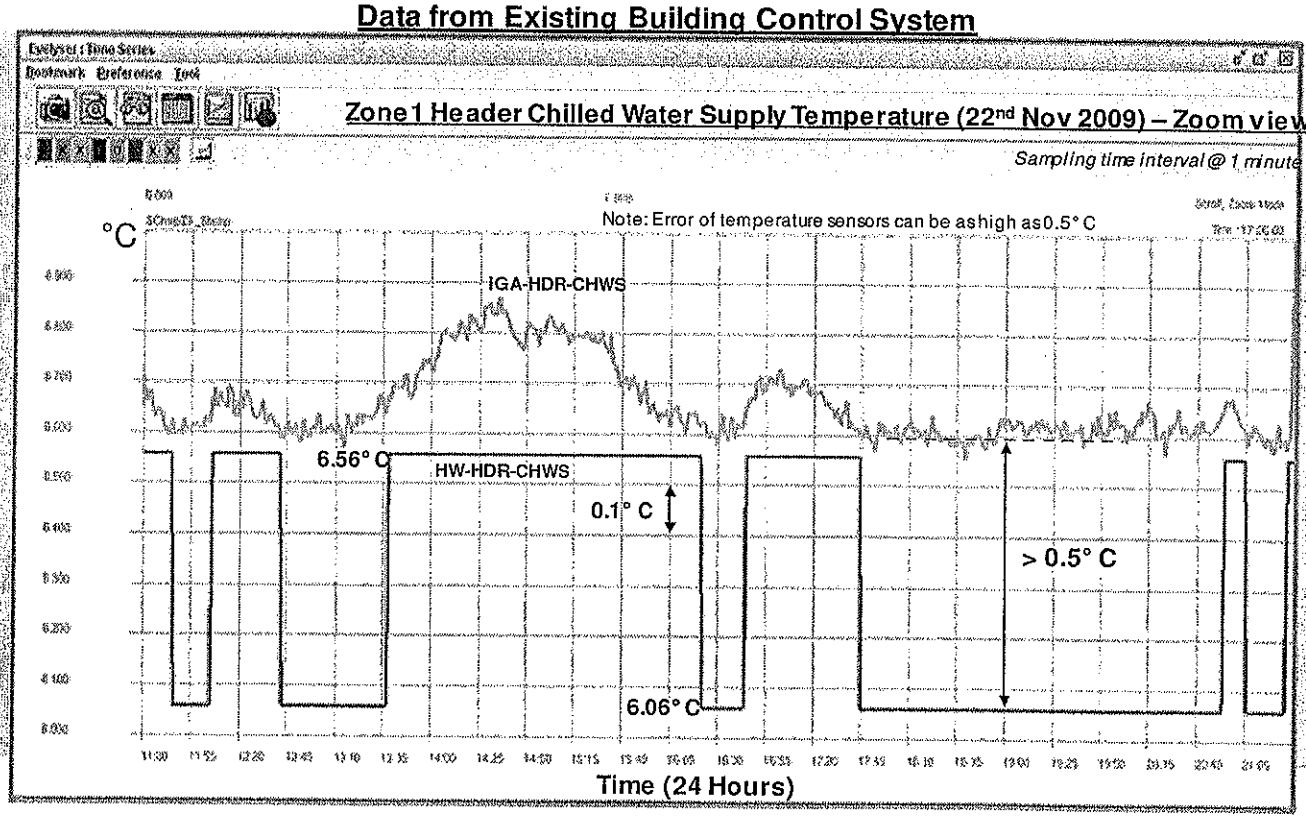

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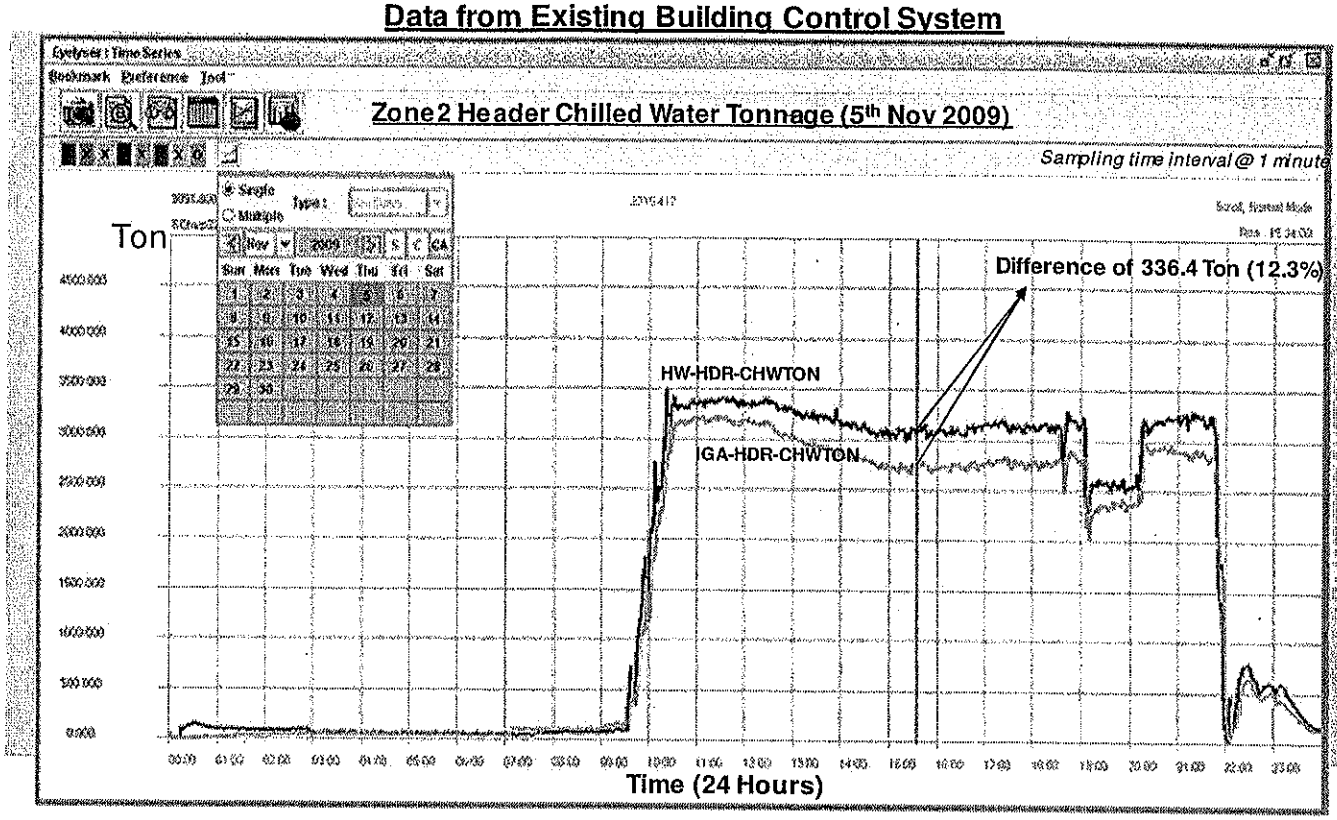

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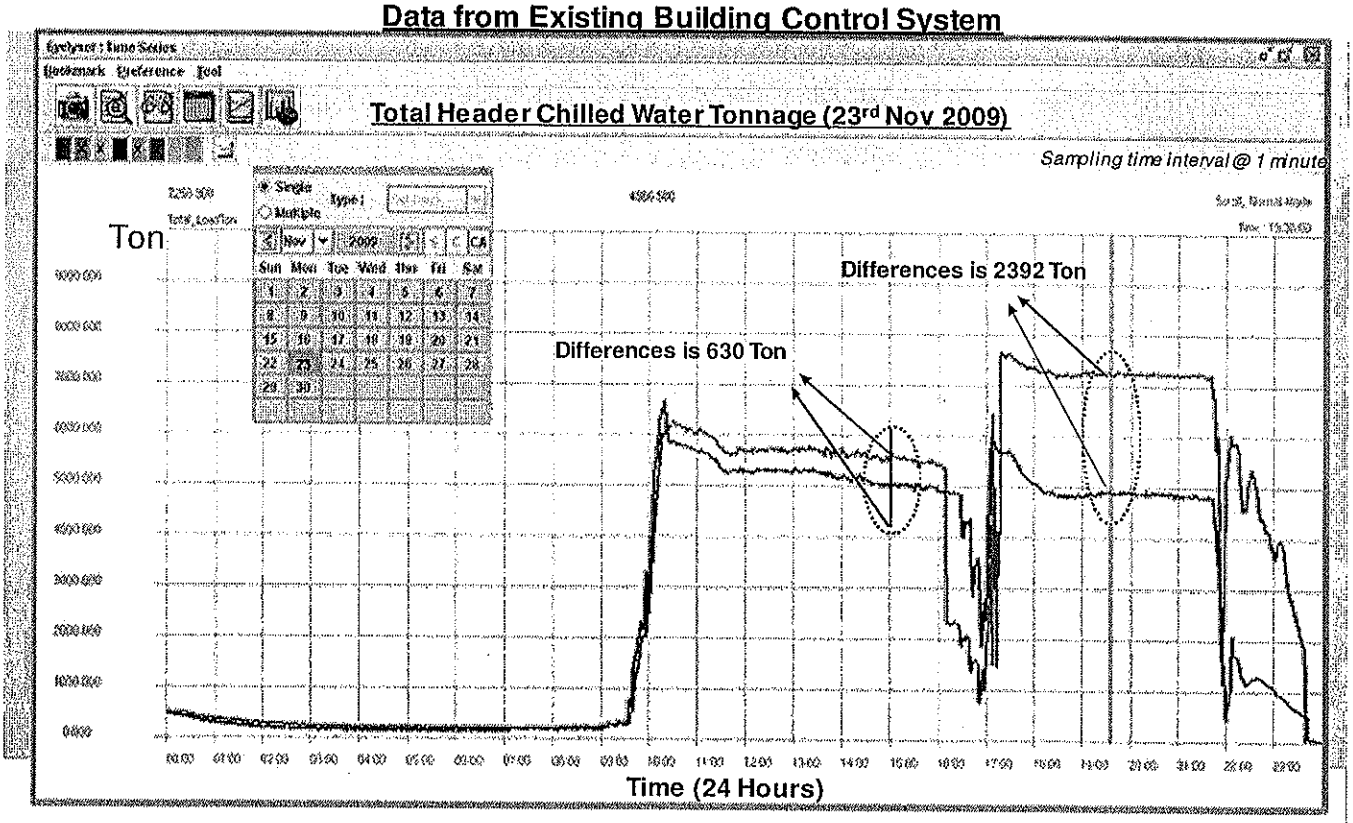
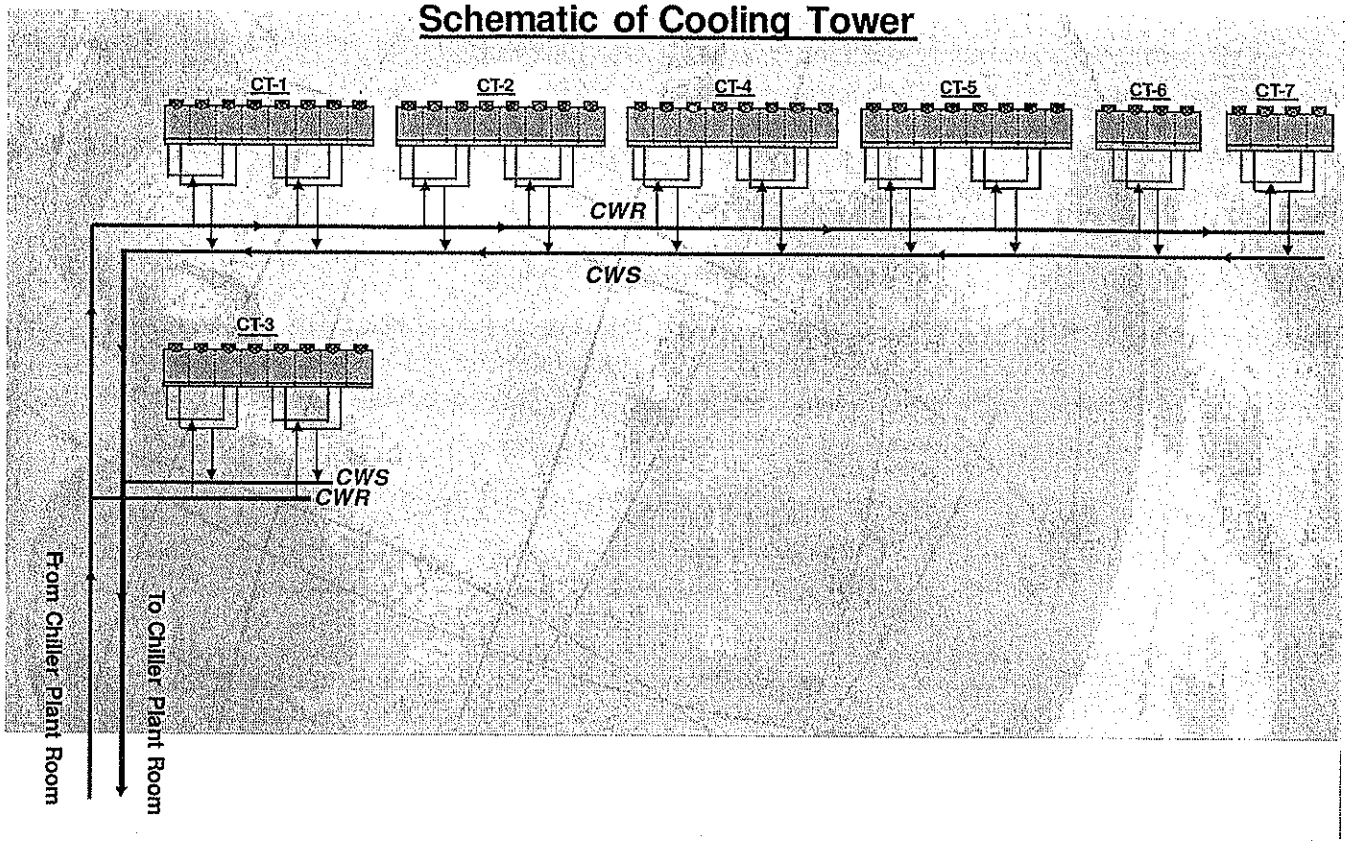


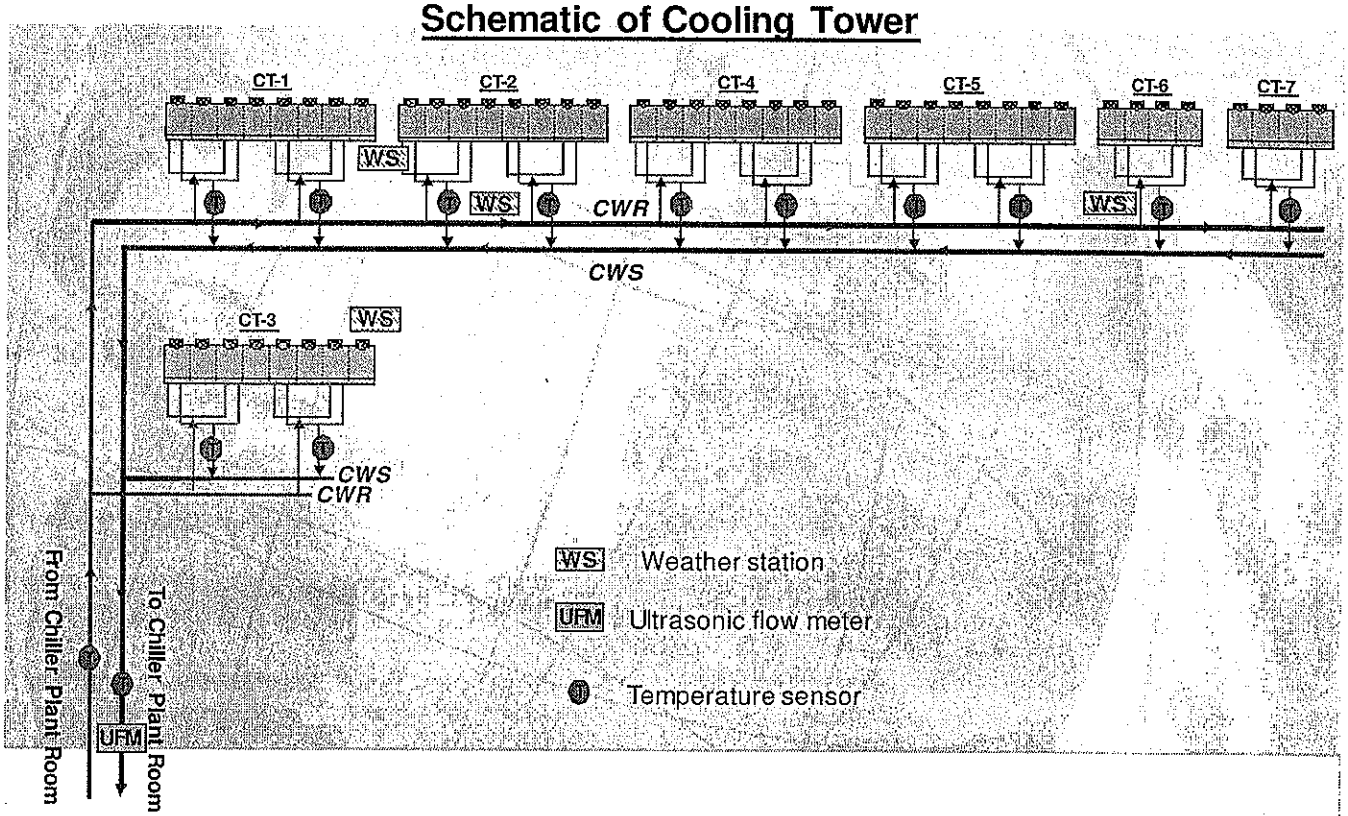
Cooling Tower

Schematic of Cooling Tower

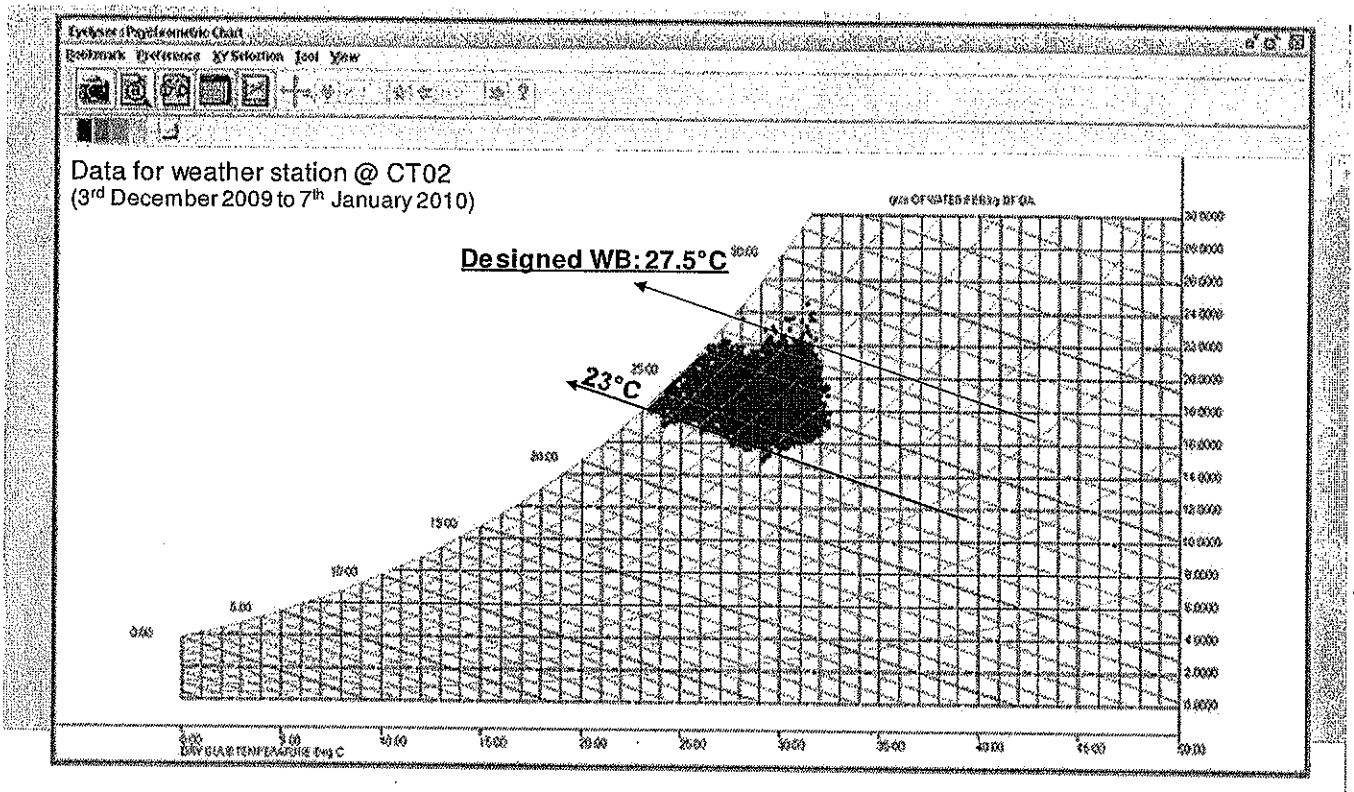


Cooling Tower

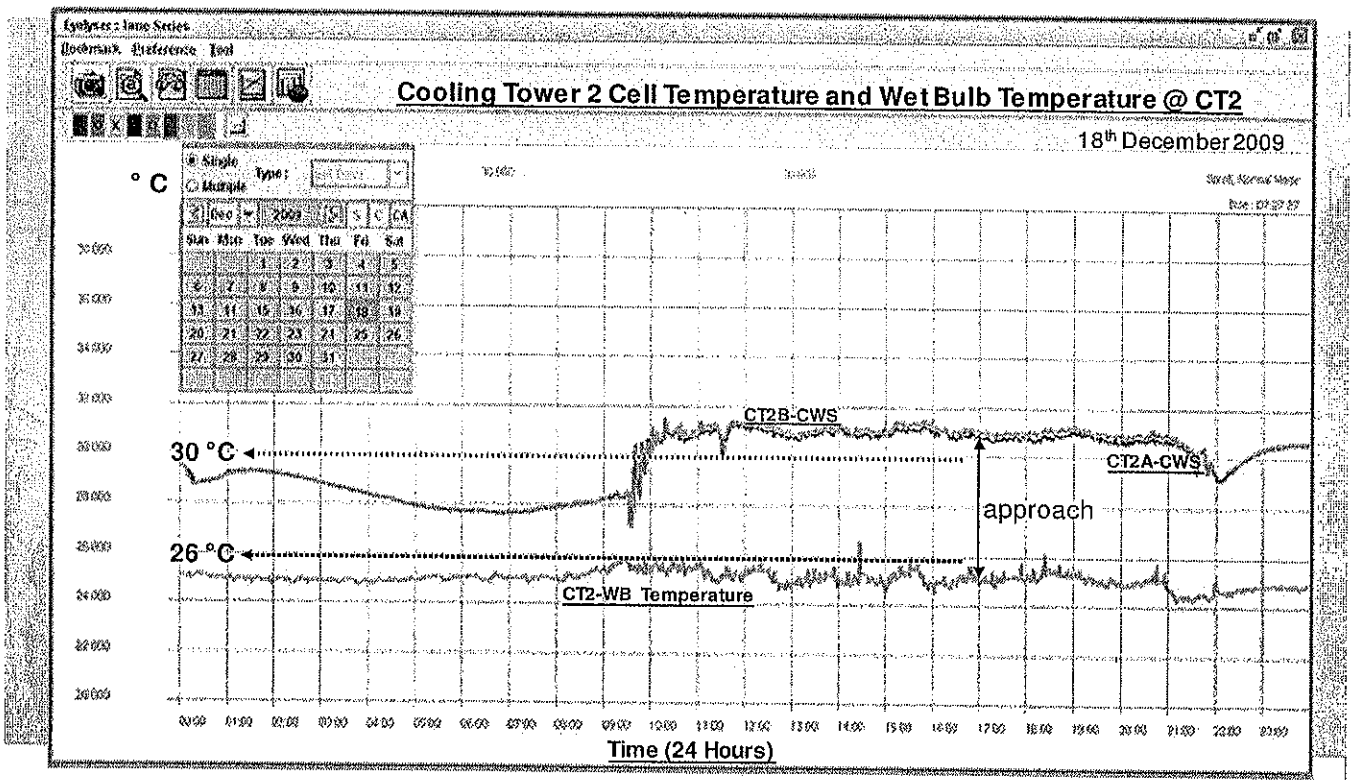
Schematic of Cooling Tower



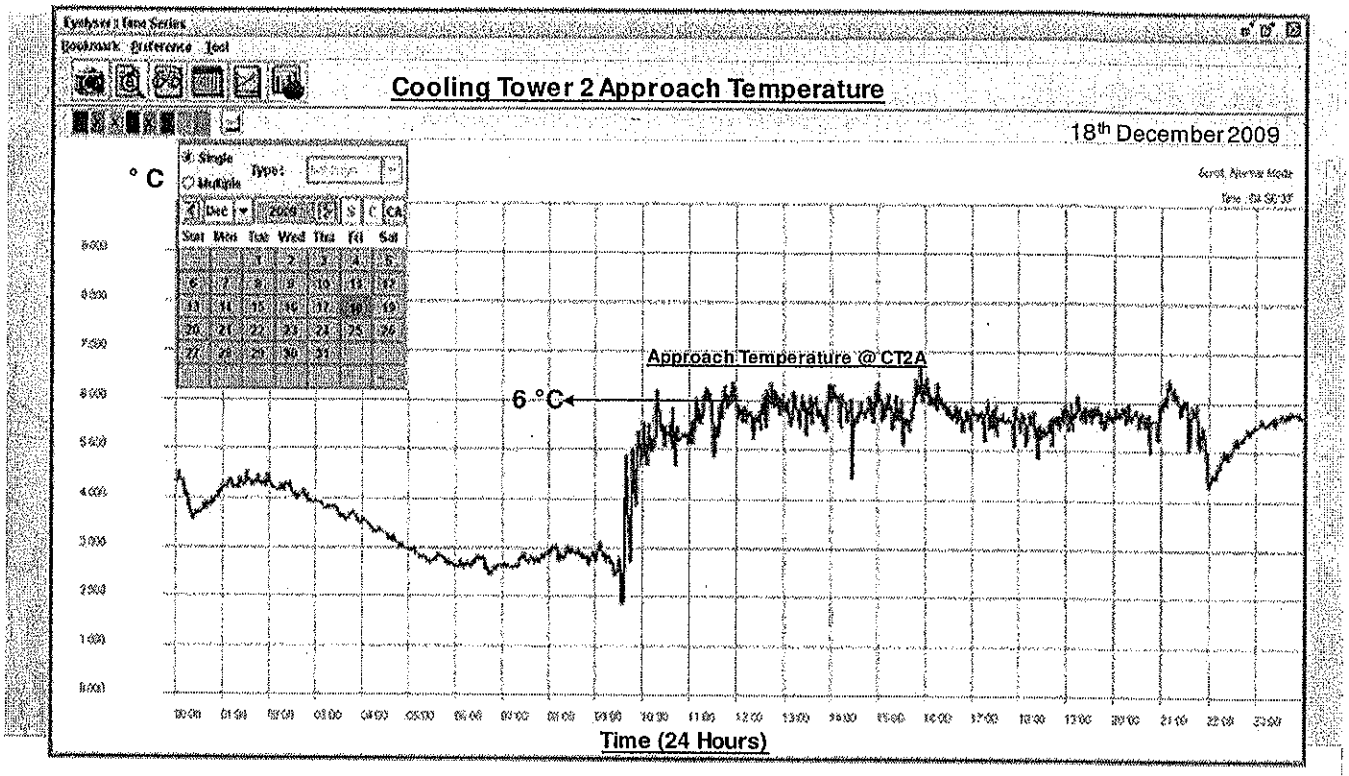
Cooling Tower



Cooling Tower



Cooling Tower



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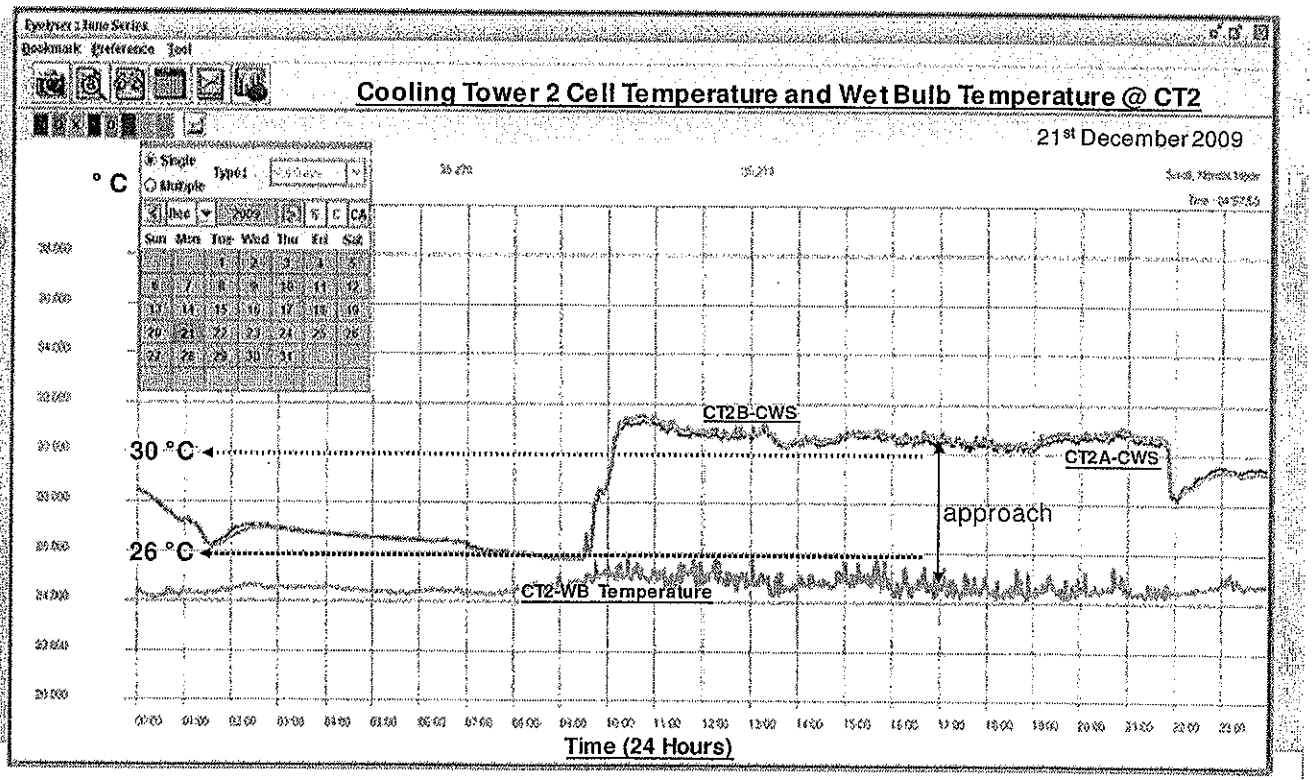
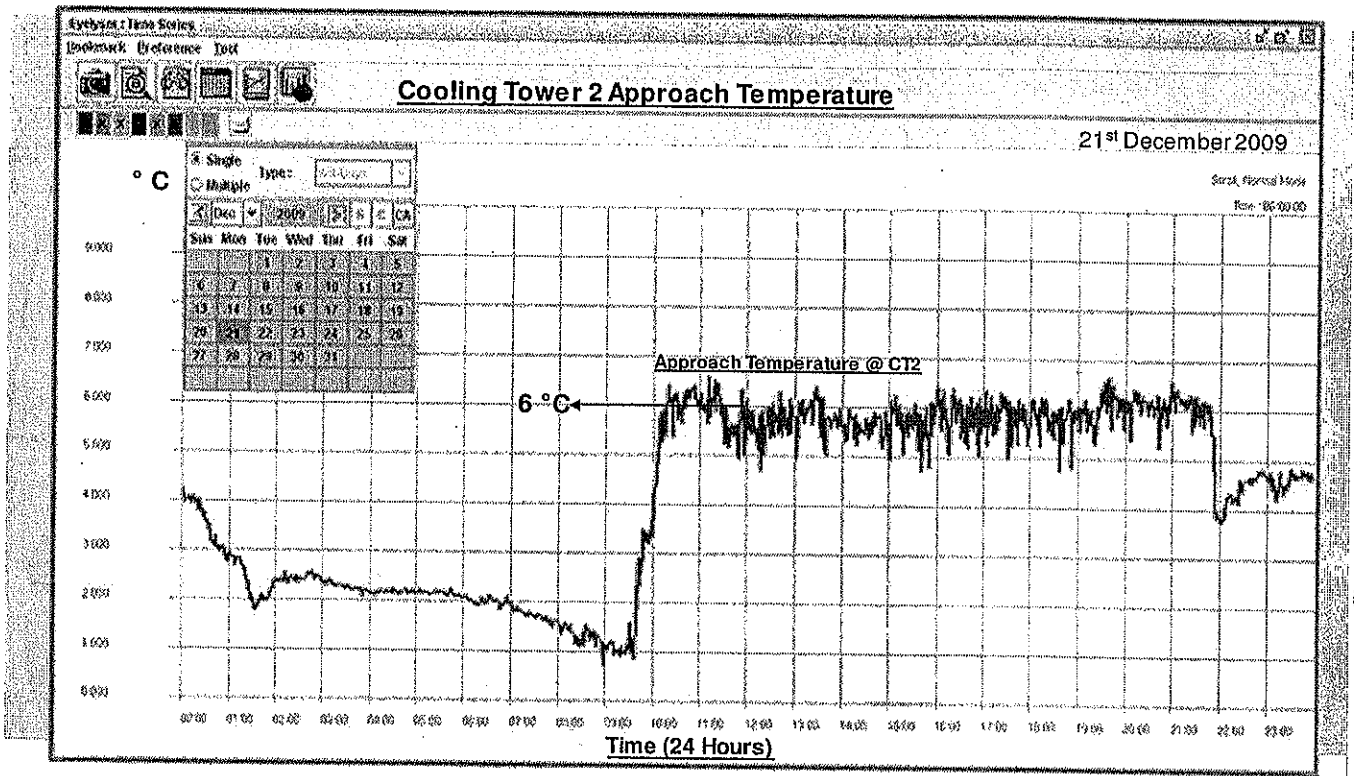
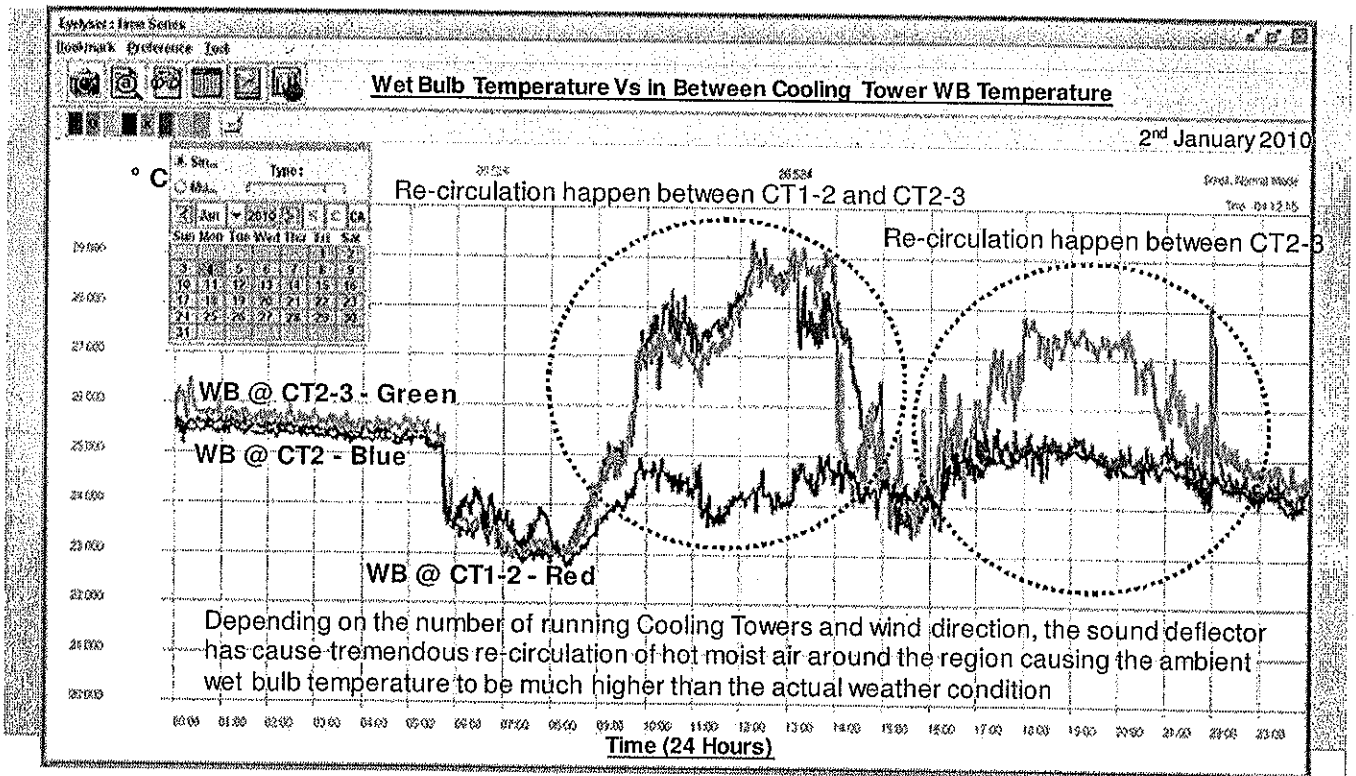
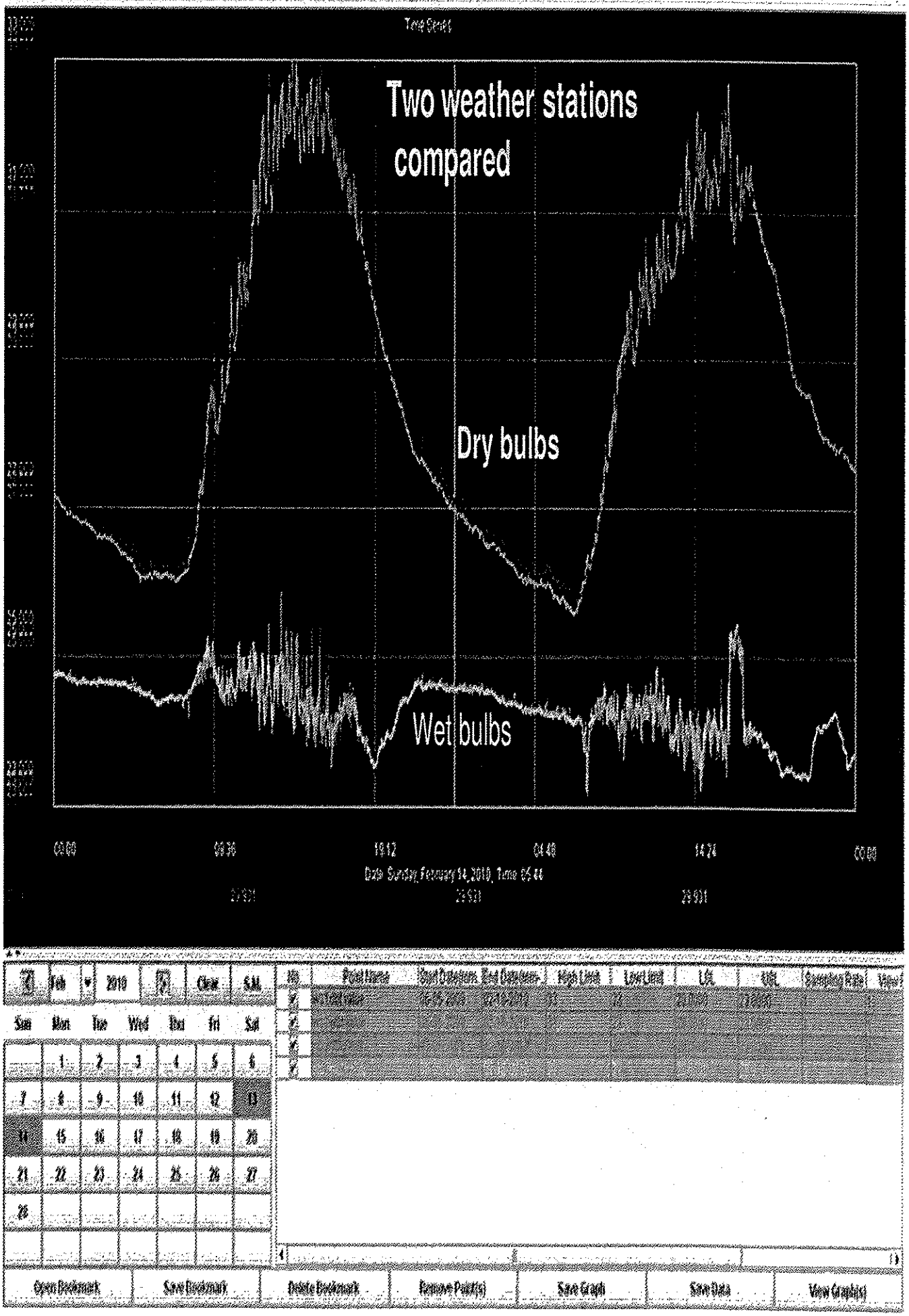


Cooling Tower

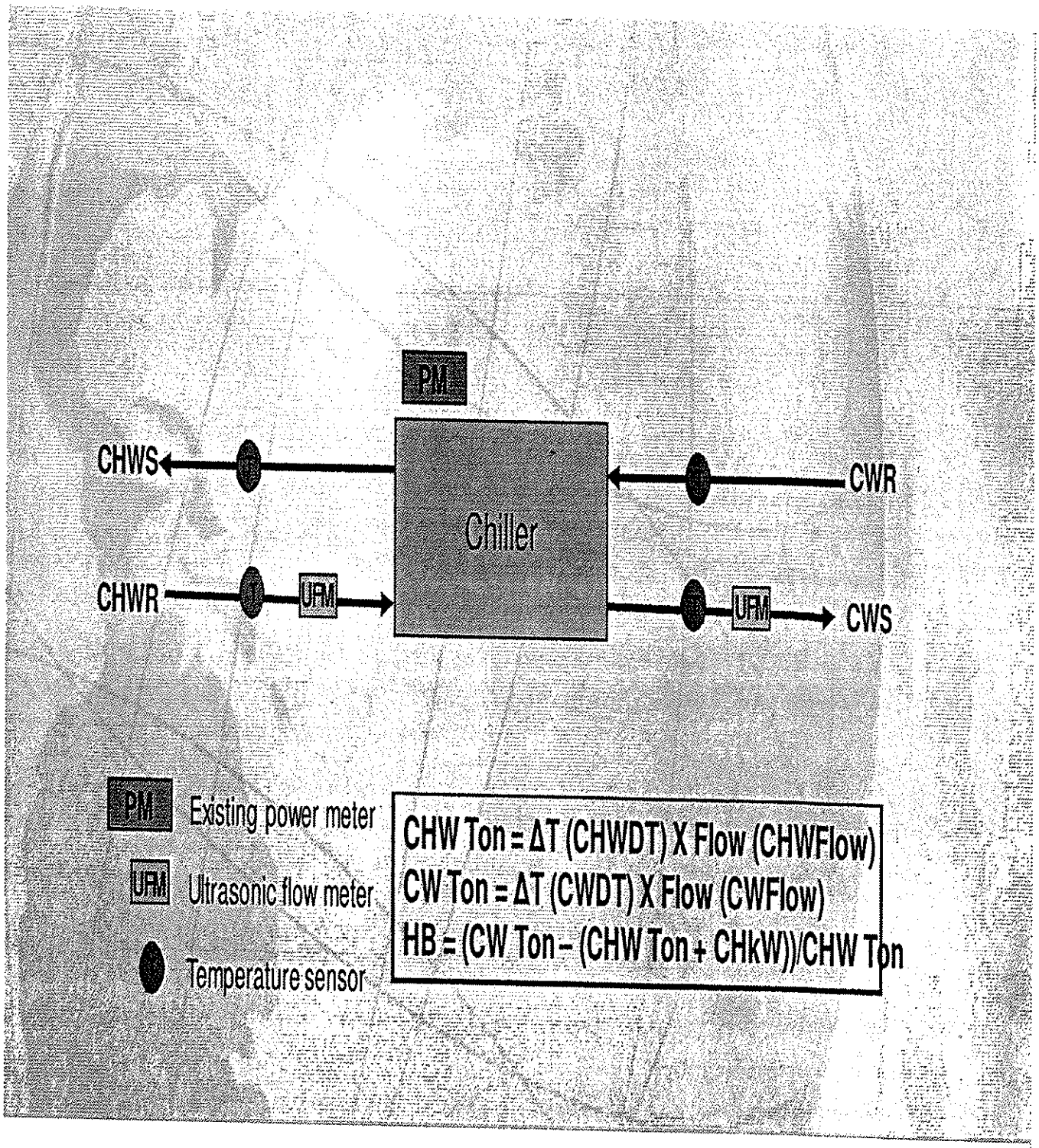


Cooling Tower

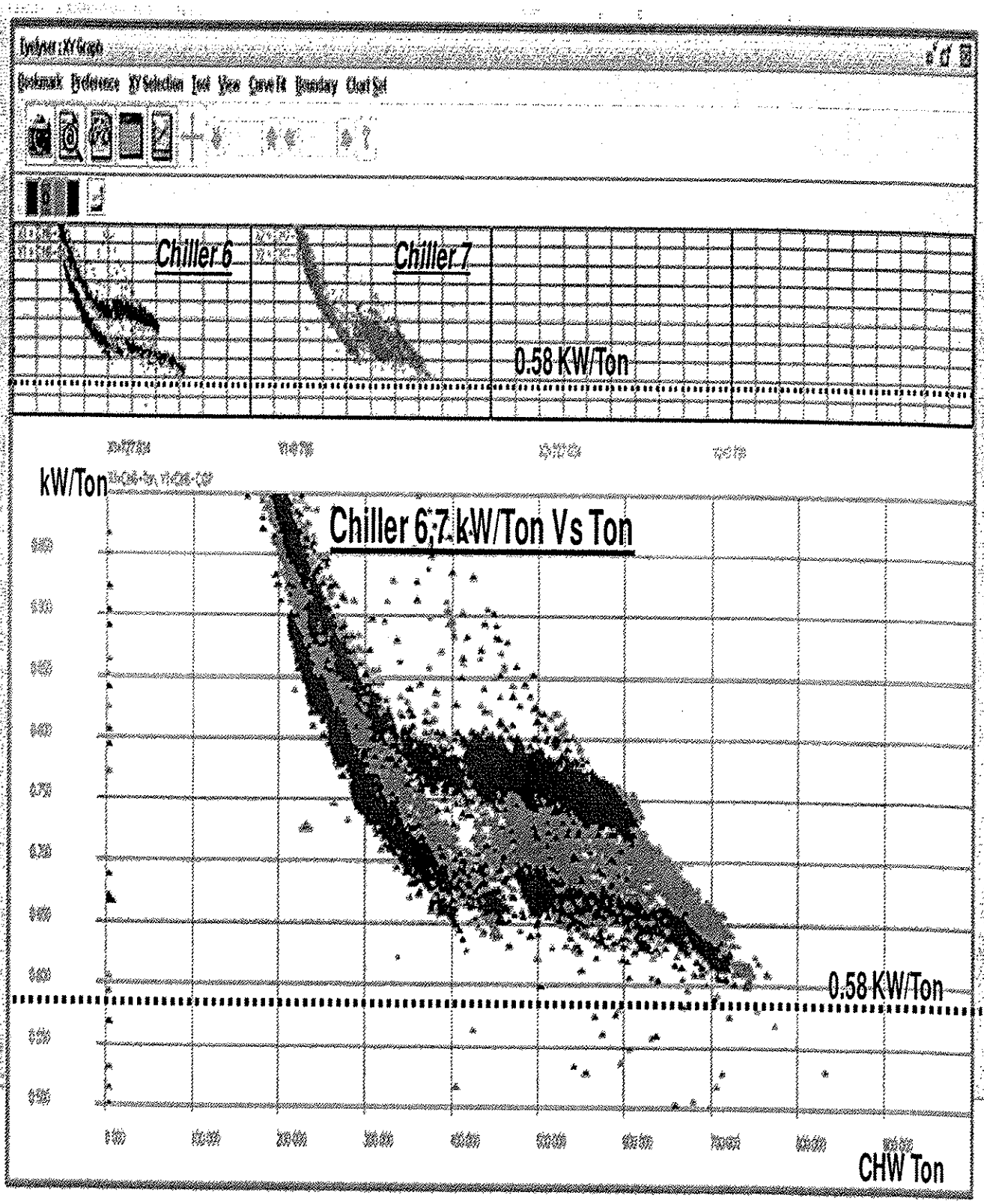



Two weather stations compared
Dry bulbs
Wet bulbs

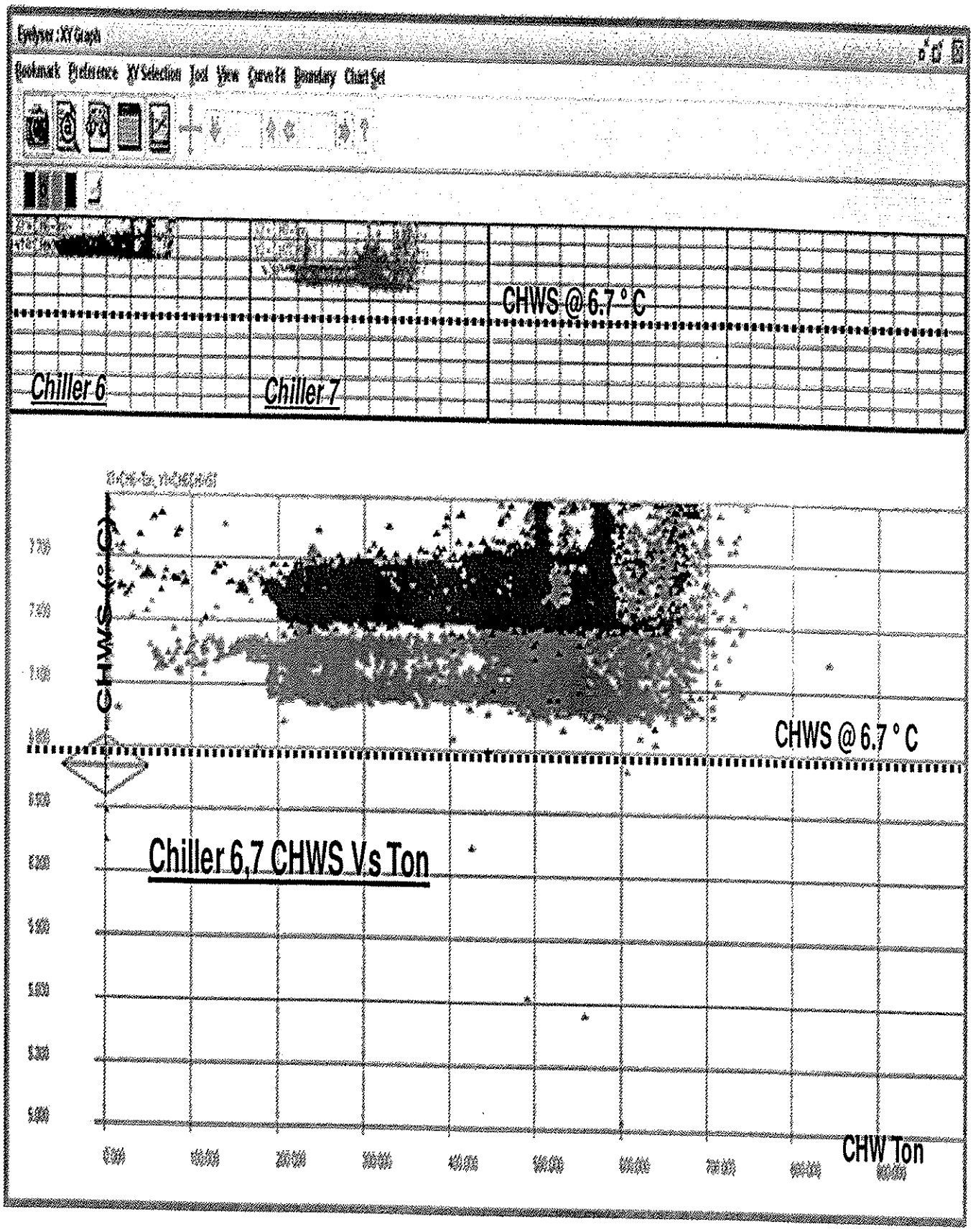
Chillers monitoring points



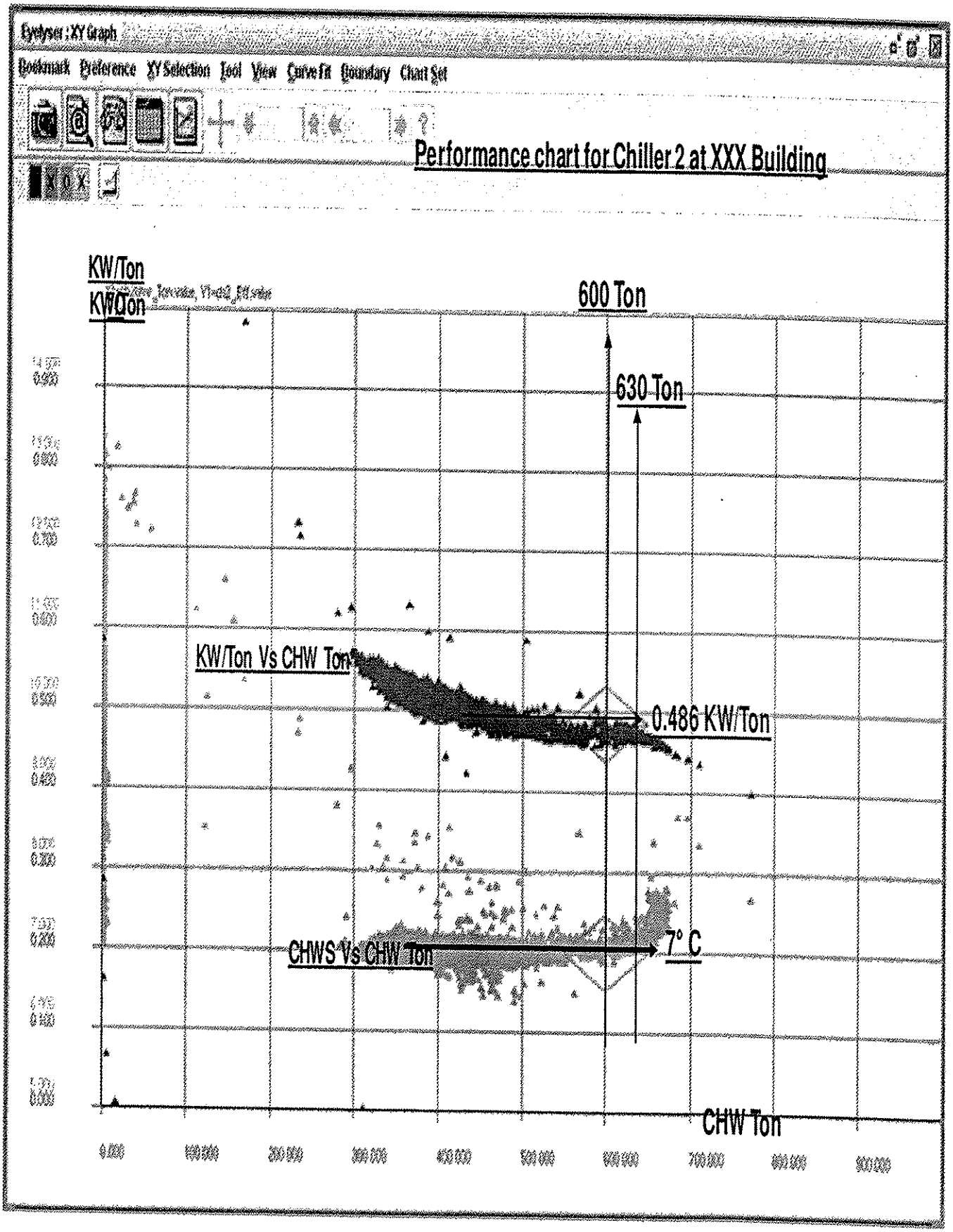
Chillers


Chiller 6
Chiller 7
0.58 KW/Ton
kW/Ton
Chiller 6,7 kW/Ton Vs Ton
0.58 KW/Ton
CHW Ton

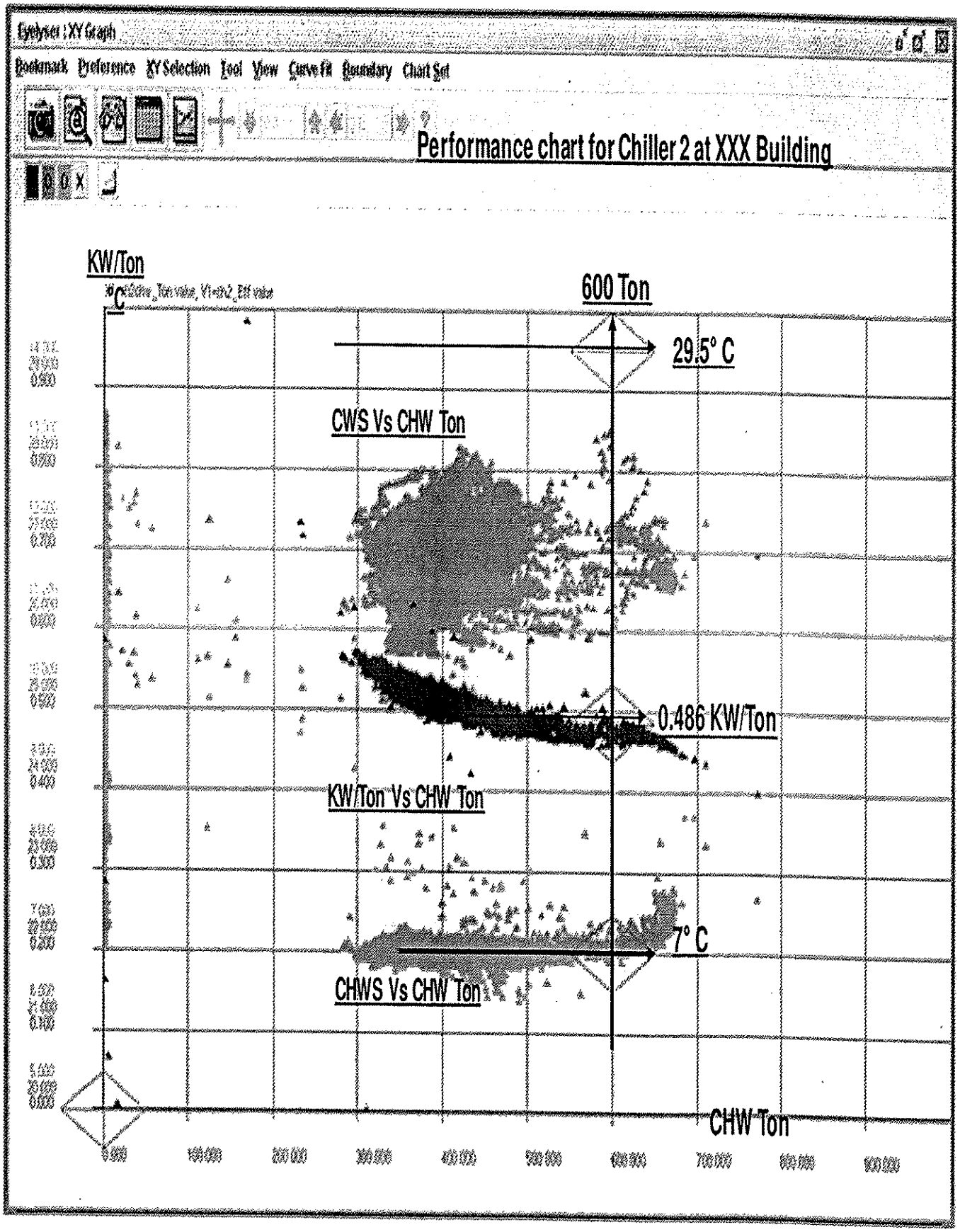
Chillers

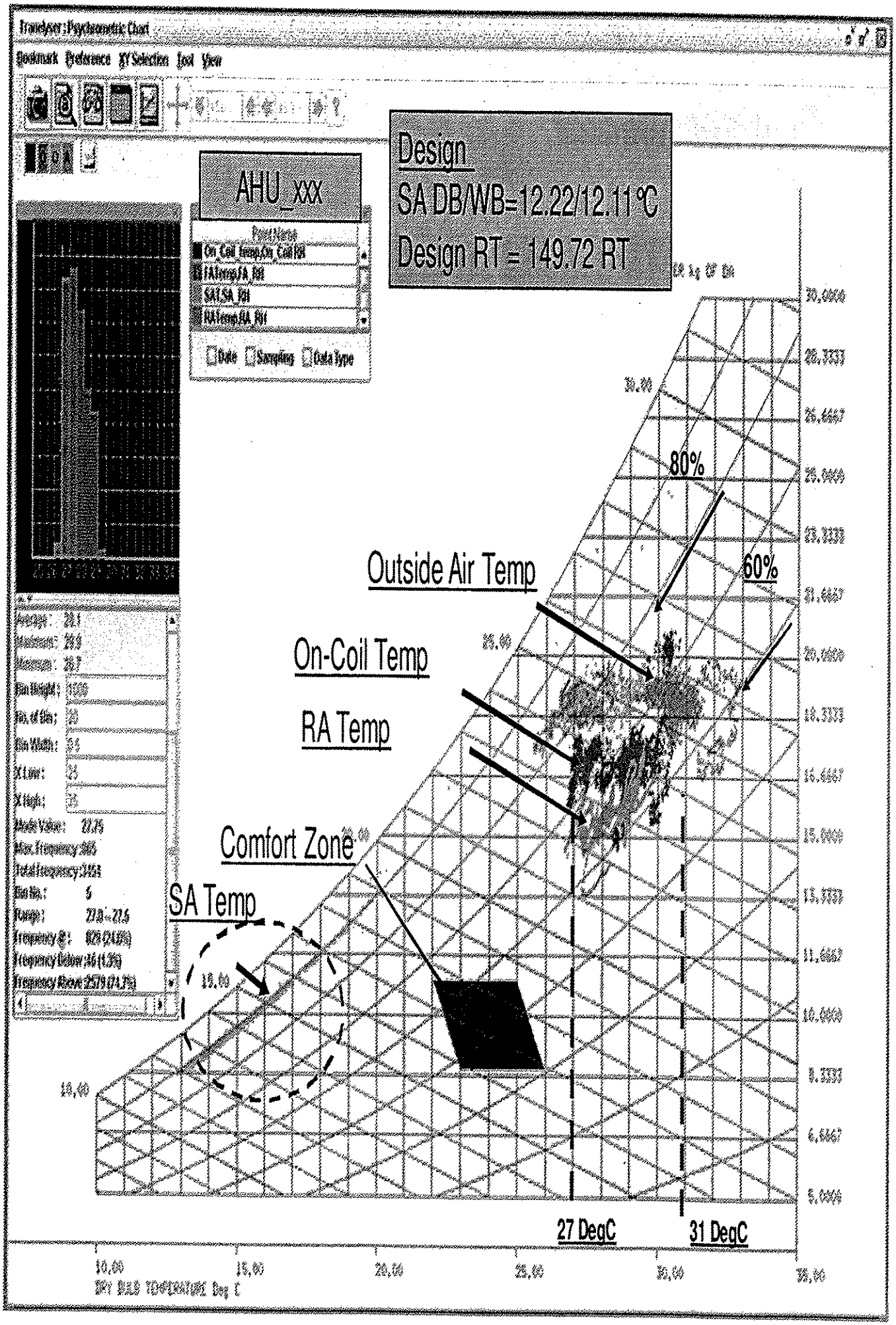

CHWS @6.7 ° C
Chiller 6
Chiller 7
CHWS (° C)
CHWS @ 6.7 ° C
Chiller 6,7 CHWS Vs Ton
CHW Ton

Retrofit Project Chillers

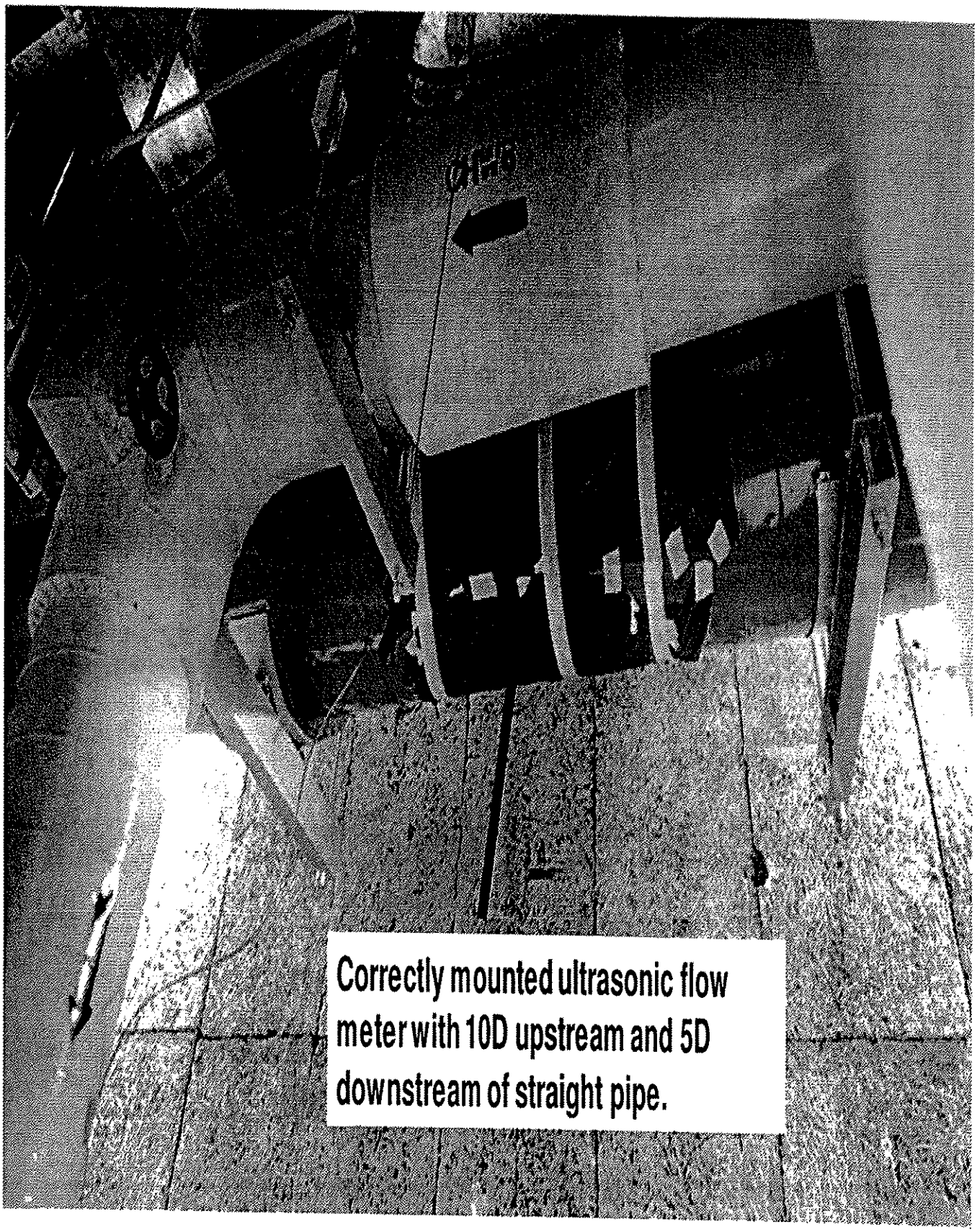


Retrofit Project Chillers

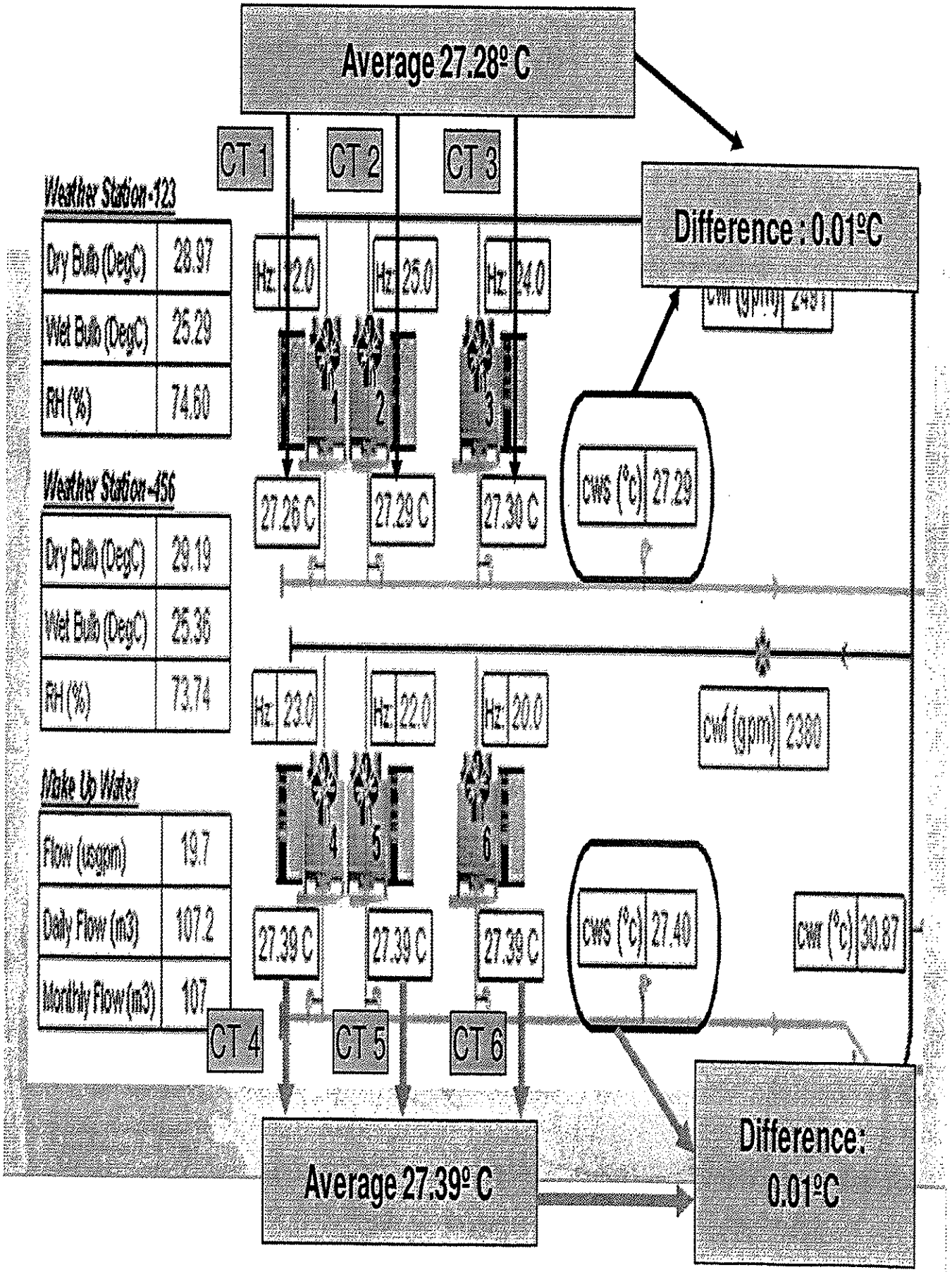


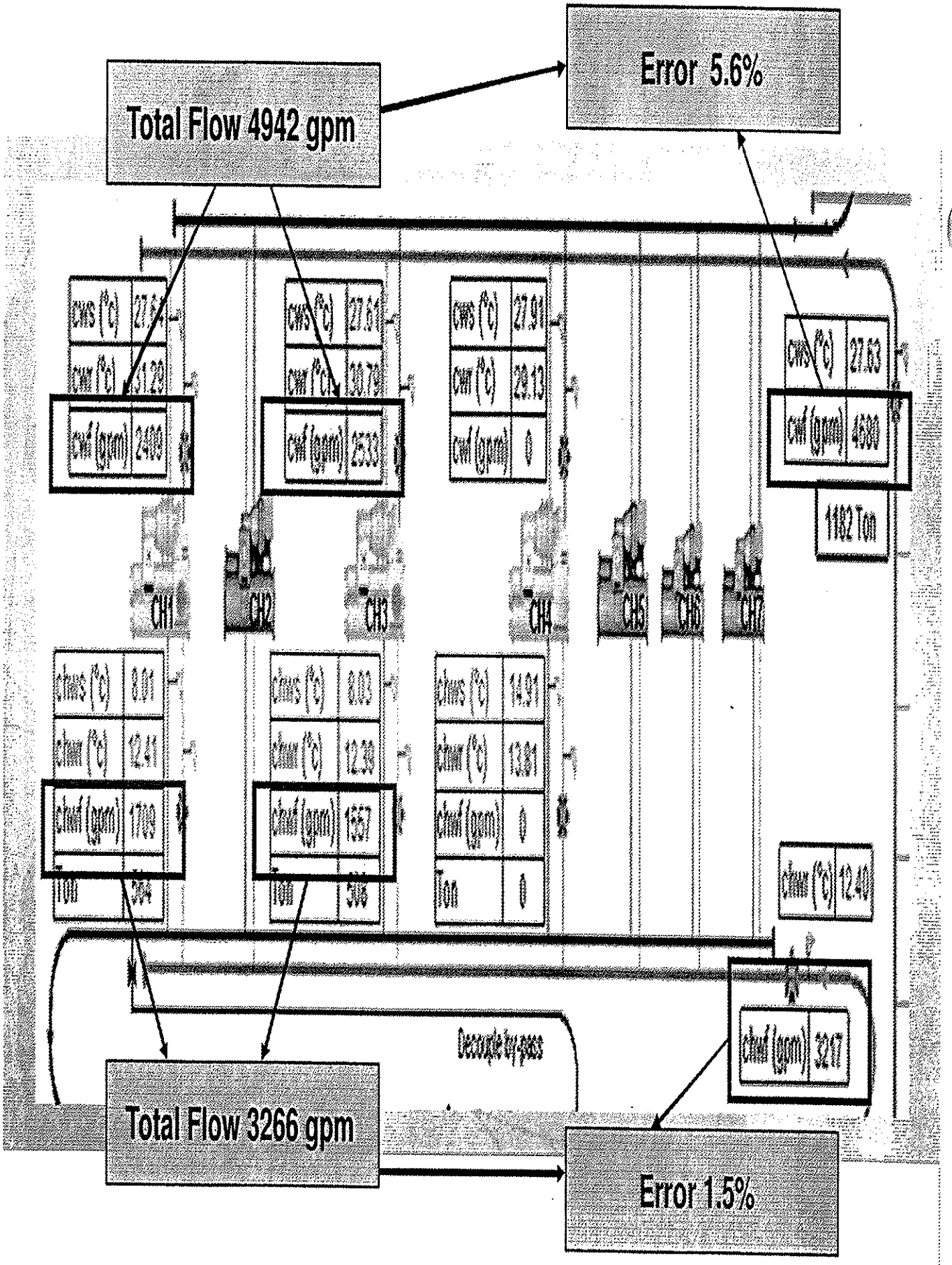

Design
SA DB/WB=12.22/12.11℃
Design RT = 149.72 RT
AHU_XXX
80%
60%
Outside Air Temp
On-Coil Temp
RA Temp
Comfort Zone
SA Temp
27 DegC
31 DegC

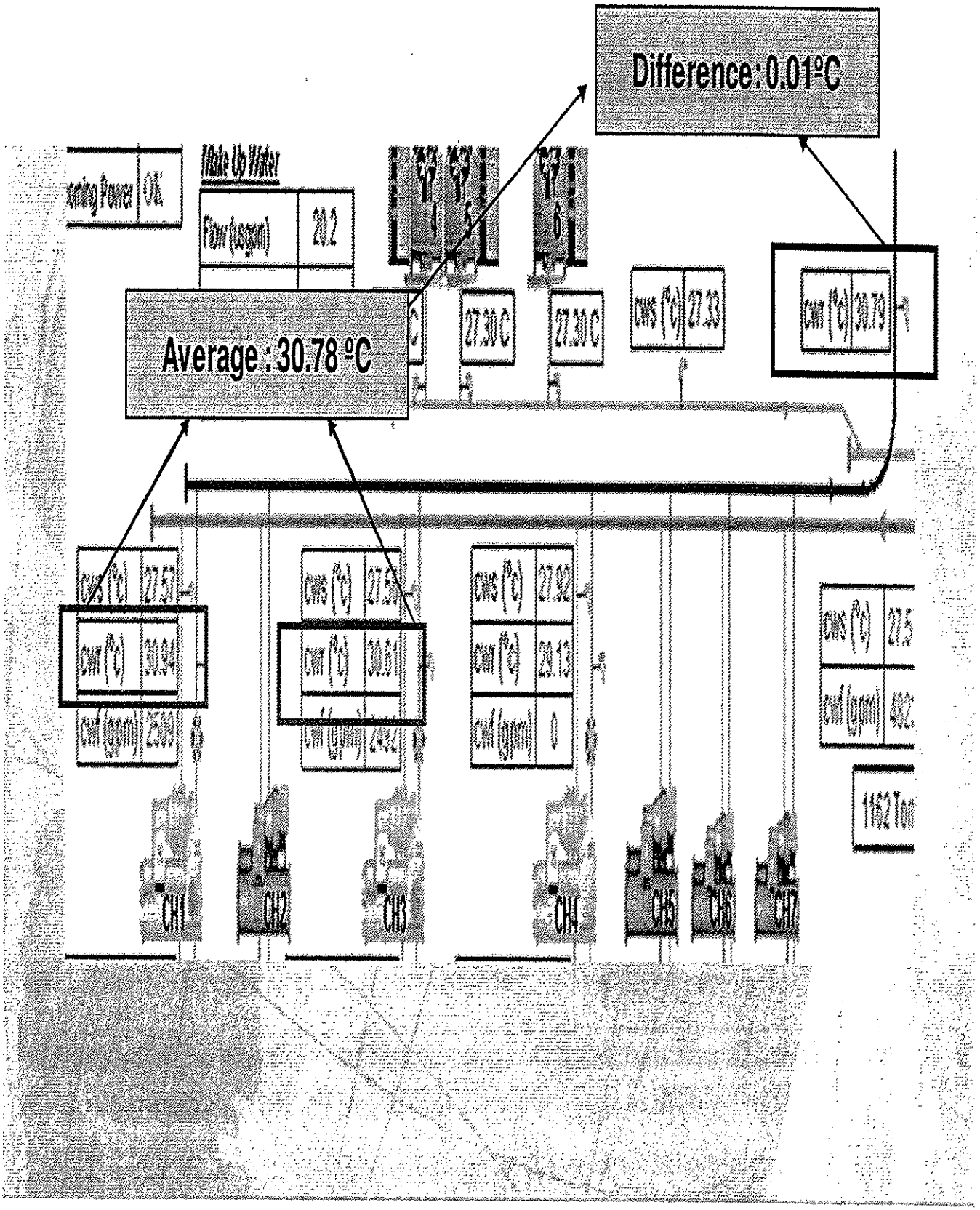
Flow measurement



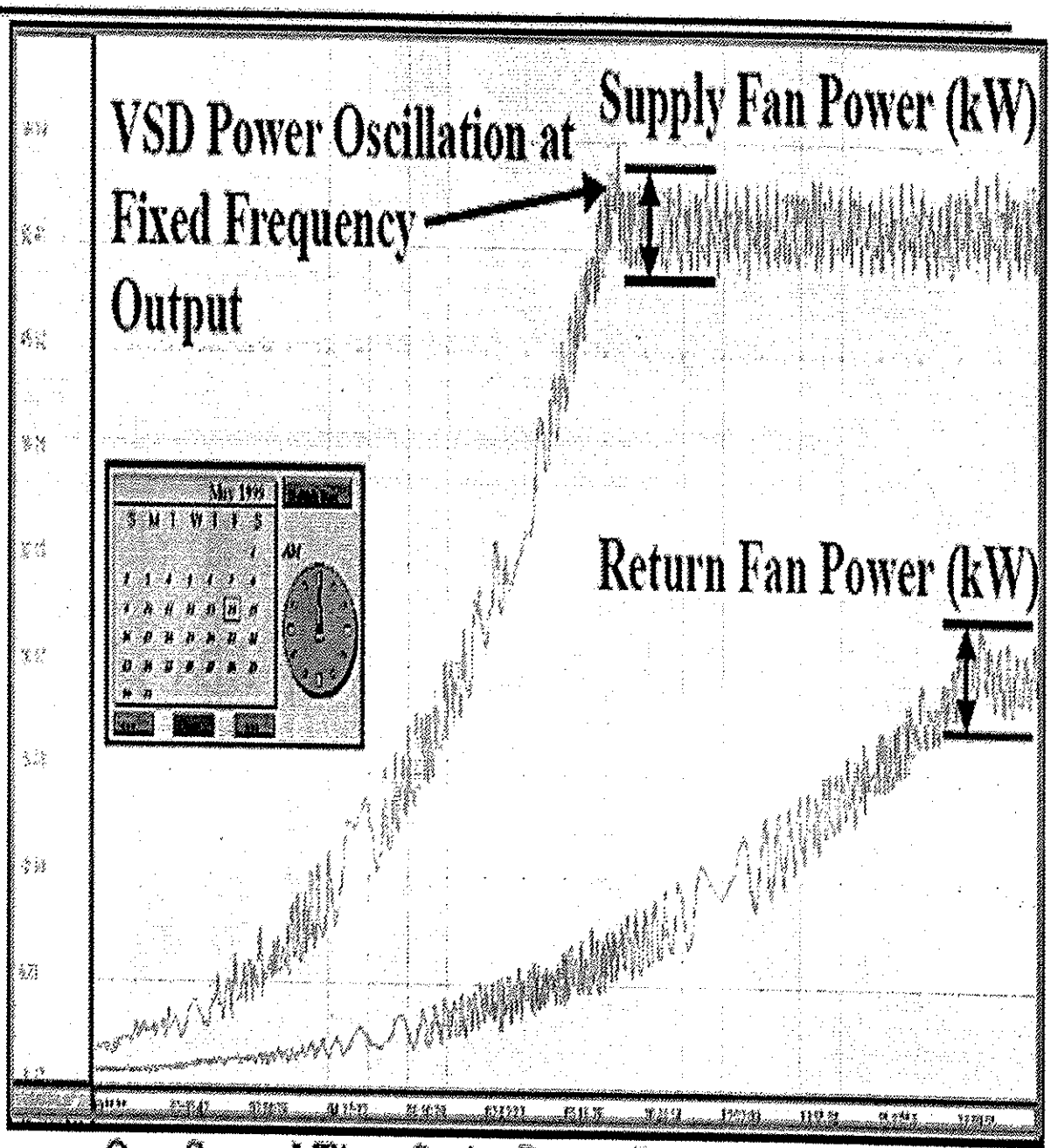
Correctly mounted ultrasonic flow meter with 10D upstream and 5D downstream of straight pipe.


Average 27.28º C
CT 1
CT 2
CT 3
Difference : 0.01ºC
Weather Station-123
Dry Bulb (DegC) 28.97
Wet Bulb (DegC) 25.29
RH (%) 74.60
Hz 22.0
Hz 25.0
Hz 24.0
27.26 C
27.29 C
27.30 C
cws (°c) 27.29
Weather Station-456
Dry Bulb (DegC) 29.19
Wet Bulb (DegC) 25.36
RH (%) 73.74
Hz 23.0
Hz 22.0
Hz 20.0
cwf (gpm) 2380
Make Up Water
Flow (usgpm) 19.7
Daily Flow (m3) 107.2
Monthly Flow (m3) 107
27.39 C
27.39 C
27.39 C
cws (°c) 27.40
cwr (°c) 30.87
CT 4
CT 5
CT 6
Average 27.39º C
Difference: 0.01ºC


Total Flow 4942 gpm
Error 5.6%
cws (°c) 27.61
cwr (°c) 30.79
cwf (gpm) 2533
cws (°c) 27.91
cwr (°c) 29.13
cwf (gpm) 0
cws (°c) 27.63
cwf (gpm) 4580
1182 Ton
CH1
CH2
CH3
CH4
CH5
CH6
CH7
chws (°c) 8.01
chwr (°c) 12.41
chwf (gpm) 1709
chws (°c) 8.03
chwr (°c) 12.39
chwf (gpm) 1657
chws (°c) 14.91
chwr (°c) 13.81
chwf (gpm) 0
Ton 0
chwr (°c) 12.40
chwf (gpm) 3217
Total Flow 3266 gpm
Error 1.5%


Difference: 0.01ºC
Average : 30.78 ºC
Make Up Water
Flow (usgpm)
20.2
27.30 C
27.30 C
cws (°c)
27.33
cwr (°c)
30.79
cws (°c)
27.57
cwr (°c)
30.94
cwf (gpm)
cws (°c)
cwr (°c)
30.61
cws (°c)
27.92
cwr (°c)
29.13
cwf (gpm)
0
CH1
CH2
CH3
CH4
CH5
CH6
CH7

Variable Speed Drive Power (At one second)



One-Second Time Series Power Data for Main Fans

The Fan controls are not set correctly and the fans are tracking each other not operating efficiently. The fans are cycling power from loose belts. This shows what the physical condition causes.

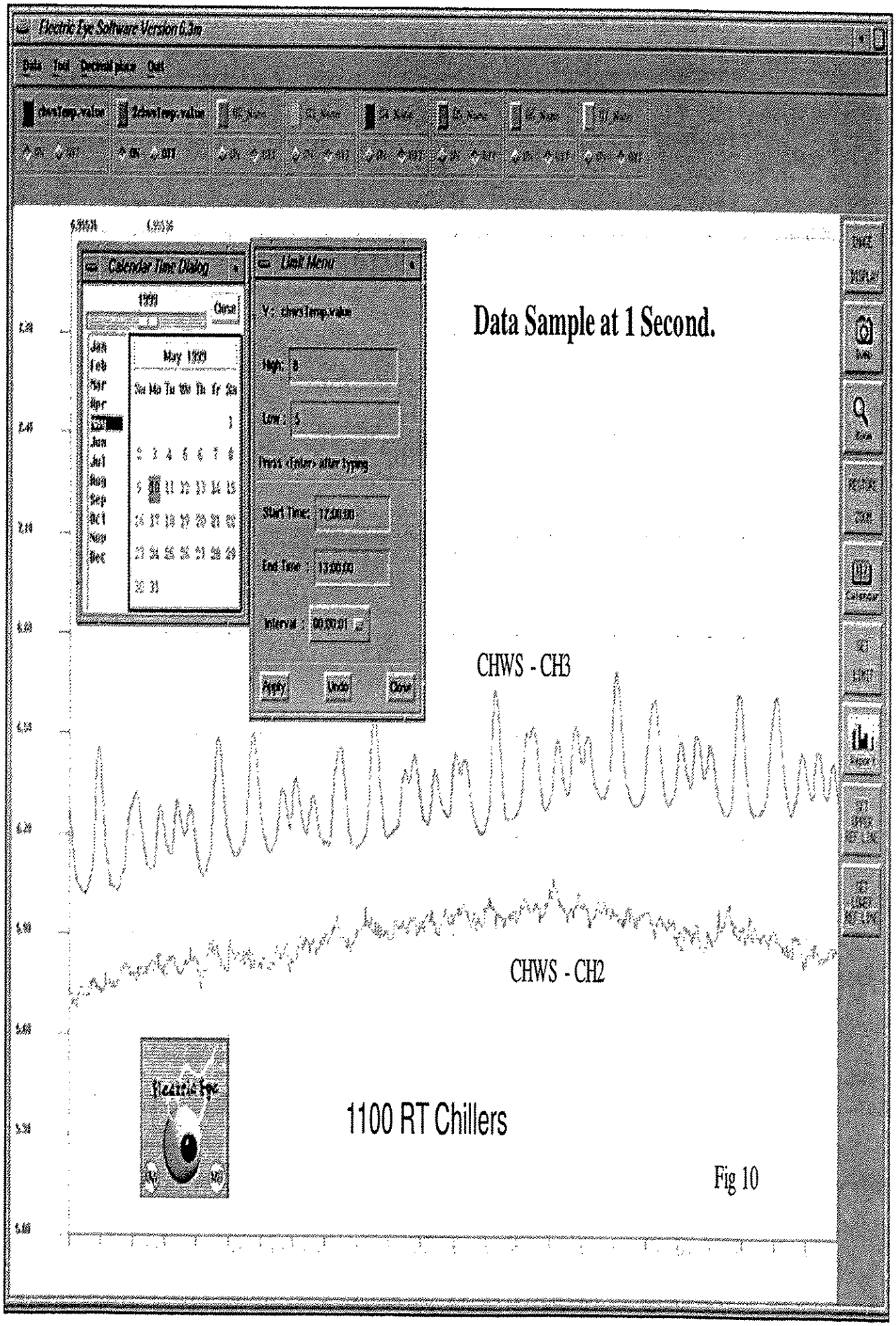
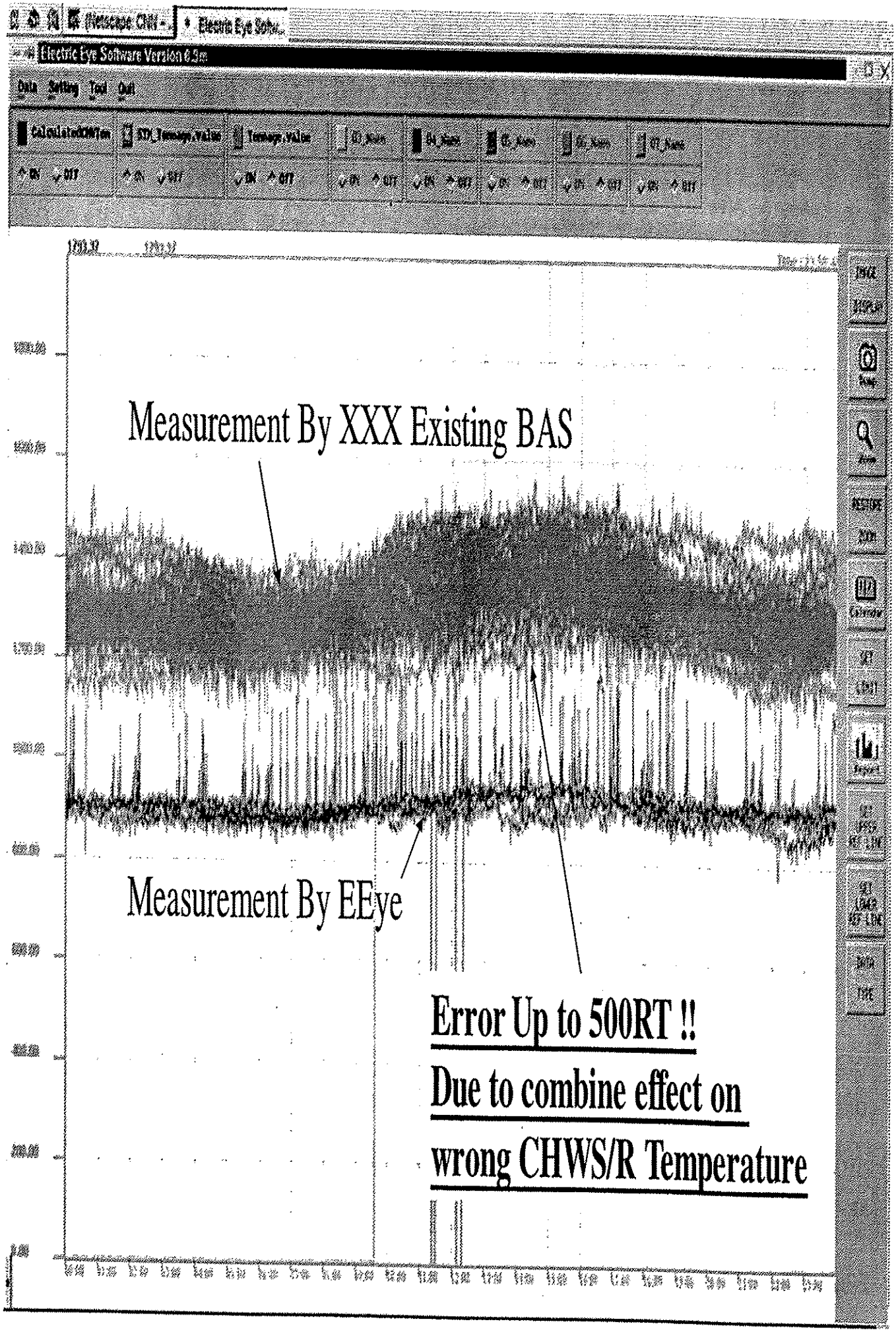

Electric Eye Software Version 6.3m
Calendar Time Dialog
Limit Menu
Data Sample at 1 Second.
CHWS - CH3
CHWS - CH2
1100 RT Chillers

Fig 10


Electric Eye Software Version 6.5m
Data Setting Tool Quit
Measurement By XXX Existing BAS
Measurement By EEye
Error Up to 500RT !!
Due to combine effect on
wrong CHWS/R Temperature

Action:
Facility people sees high CHWR-12C,more than 100% Load of 2-chillers from TA-display

Fact:
Wrong reading on CHWR
Wrong calculation on tonnage

Action
Turn on 3rd chiller and observe 100%load displayed on micro-panel of all chillers

Fact :
Display on micropanel
100% electrical ≠100% cooling load
Chiller2(520RT) 100%electrical load but only 50% cooling part load
and operating around 1.35kW/RT

Waste of 400kW power,3,456,000kWh
$320,000 electrical bill per year