Energy Efficiency in Buildings

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Why Energy Efficiency in Buildings

- High cost of Electricity – Tariff for Commercial Buildings charged by EBs is in the highest category.
- Likelihood of further enhancement in tariff as the states are facing shortages and buying power at very high rates
- Major Consumption is in Air conditioning – Maximum savings possibilities are also in AC.
- Lighting consumption very high – Savings are relatively easy to achieve.
- Diesel Generation cost rising continuously as fuel cost is rising.

Factors Relevant for Buildings

- Common area energy cost is high
- High Maintenance cost
- High failure rate of luminaries
- No check on the energy consumption in common areas and own premises
- Failure of electronic equipment
- No expertise on energy consumption and cost analysis
- No analysis being done for improving Energy Equipment performance

Factors Relevant for Facility Manager of Commercial Complexes

- Manual collection of consumption data
- Consumers' presence and co-ordination is required for collection of data on energy consumption
- Disagreement of energy consumption by consumers.
- Cumbersome to prepare bills
- Difficulty of obtaining run hours of equipment for maintenance.
- No check on diesel consumption.

We are
the global specialist in energy management

A world where we can all

achieve more while using less

of our common planet

Helping people make the most of their energy

Energy production	Energy Management	Energy Usage
•Thermal •Nuclear •Genset •Hydro •Solar •Wind	Making energy: •Safe •Reliable •Efficient •Productive •Green	•Appliances •Lighting •HVAC •Lifts •Motors •Machines •Conveyors •IT servers

A Global Company

INR 119,450 crore revenue in 2009

114,000 people in more than 100 countries

>200 factories around the world

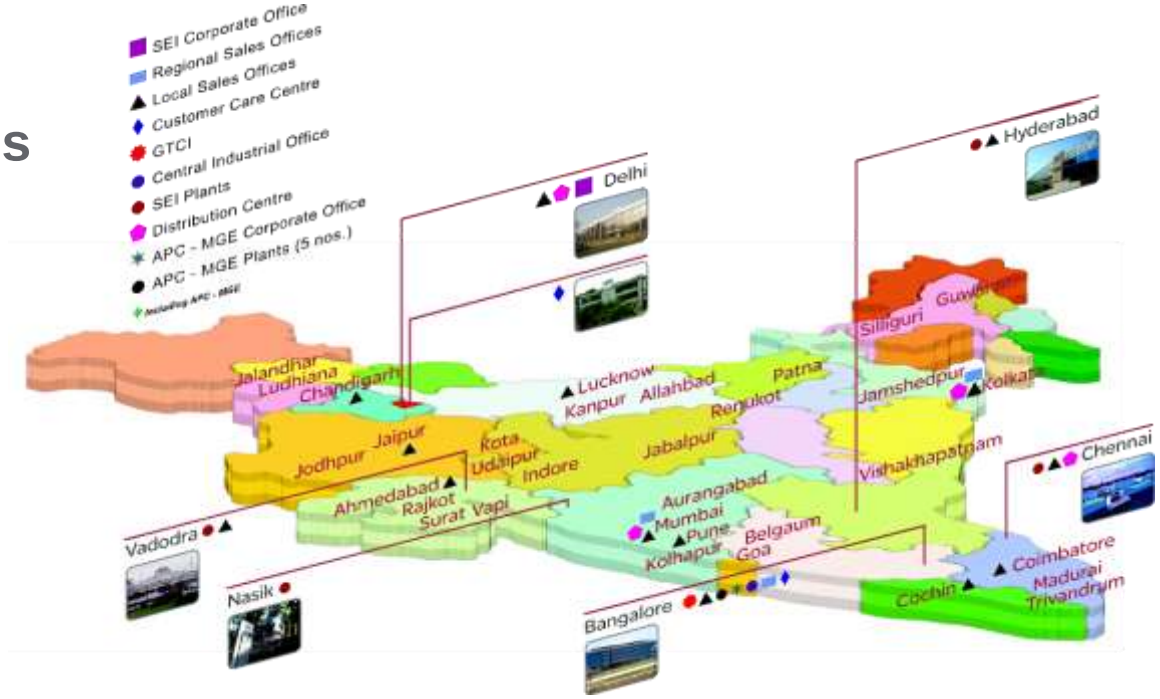
R&D centres in **25 countries**

Schneider Electric in India

6,500 employees

9 manufacturing sites,

6 R&D centers



400 authorized partners (Distributors, System Integrators and Panel Builders)

One Regional Project & Engineering Centre

* Energy Efficiency

Energy Conservation Act 2001

Energy Conservation Building Code

Energy Conservation Building Code - Applicability

- **Applicability for Buildings having**
  - **> Connected load of 500 KW or contract load of 600 KVA**
  - **> Floor Area over 1000 sq m**
- **Code applies to**
  - **> HVAC**
  - **> Exterior and Interior Lighting**
  - **> Electrical Power and motors**
- **Code exempts**
  - **> Factory buildings**
  - **> Single family buildings**
  - **> Multi family buildings of three stories or less**

ECBC – HVAC Requirements

- Equipment Efficiency are specified :

  > Air cooled air conditioners 5 tons and above -
  COP 2.93 to 3.08

  > Water cooled air conditioners 5 tons and above –
  COP 3.22 to 4.10

  > Air cooled chillers 150 tons above - COP 2.95<>3.05

  > Centrifugal water cooled chillers- 150 to 300 – COP <5.80>6.30

ECBC - HVAC

> Reciprocating compressor water cooled chiller all sizes – COP 4.20

> Rotary screw & scroll compressor water cooled chiller 150 – 300 tons

COP < 4.70 > 5.40 > 5.75

- Performance tables for Heat pumps, furnaces and boilers
- HVAC Controls, duct insulation and sealing.

ECBC - Lighting

- Lighting controls
  - Automatic shutoff for interior lighting in buildings above 500 sqm
  - Occupancy sensors for areas above 30 sqm such as conference/meeting rooms, class rooms, storage spaces etc.
  - Other spaces with programmed timers or occupancy sensors
  - Luminaire controls in day-lighted areas.

ECBC - Lighting

- Interior Lighting power density specified:
  - By Building Area method in Watts per sqm (eg. Library, Theatre, Hotel etc)
  - By Space Function method in Watts per sqm (eg. Seating, Operating room etc)
- Method of wattage calculation for installed interior lighting
- Exterior lighting power specified in table

ECBC – Electric Power

- Transformers: Losses for 11KV and 22KV transformers are specified for capacities ranging from 100 KVA to 1000 KVA.
- Motors: Energy efficiency for 1.5 HP to 100 HP motors are specified.
- Power factor correction
- Metering: Over 1000 KVA meters should measure demand(KVA), energy(KWH), PF, Phase current, voltage(line and phase) and THD. Below 1000KVA measure KW, KWH and PF
- T & D losses not to exceed 1 %

ECBC

- Lighting:
  - > Automatic Light Shutoff
  - > Space control
  - > Interior Lighting Power Density(LPD) in Watts/sqm
  - > Exterior Lighting norms
- Electric Power:
  - > Transformer – max losses specified
  - > Motors – min acceptable efficiency
  - > Power Factor correction & energy monitoring

Common Problems in Buildings

- Large percentage of energy in air conditioning followed by lighting.
- Usage of florescent tubes and CFLs results in low PF.
- Unrelated load consuming areas result in exceeding sanctioned demand
- Huge differences in per unit charges when supply is from EB or DG. Need for separate billing for consumers

Products for Buildings and Commercial Complexes

ACCREDITATION

Schneider Electric (thro' CONZERV) is accredited for Energy Audit by Bureau of Energy Efficiency, Ministry of Power,Govt of India under Energy Conservation Act 2001

Dual Source Energy Meter - Features

- Measures
  - W
  - DG, EB, Total
    Wh, On.hrs, OLD
- 96 X 96 construction
- Bright LED display, %A Load Bar
- No CLR – only thru EBS
  - Wh Readings retained
- New Key Lock function
  - Press < + > Keys – Toggles Lock
  - 2 + 16 sec Display for W
- Turbo key – One Touch
  - Wh.EB, Wh.DG directly
- RS485 option
- EBS Software
  - e Billing

Dual Source Energy Meter -Benefits

- OLD register to view last Energy readings
- Can view separately the duration of EB/DG On hrs
- Total Energy and ON hours
- Overload Detection thru %A Load Bar
- 3 phase and Phase-wise power
- CT Rev auto correction (since no IE), wiring check
- Gen smart-sense
  - 8-300v AC/DC. Can sense 24V DC, 230V AC

Dual Source Energy Meter - Applications

- Townships/apartments
- Shopping Malls/Commercial complexes
- Hotels
- Any Installation which requires split energy monitoring for two conditions
  - e.g.- Running & Idle
  - Enabled by Smart Sense

Solution – Energy Billing System

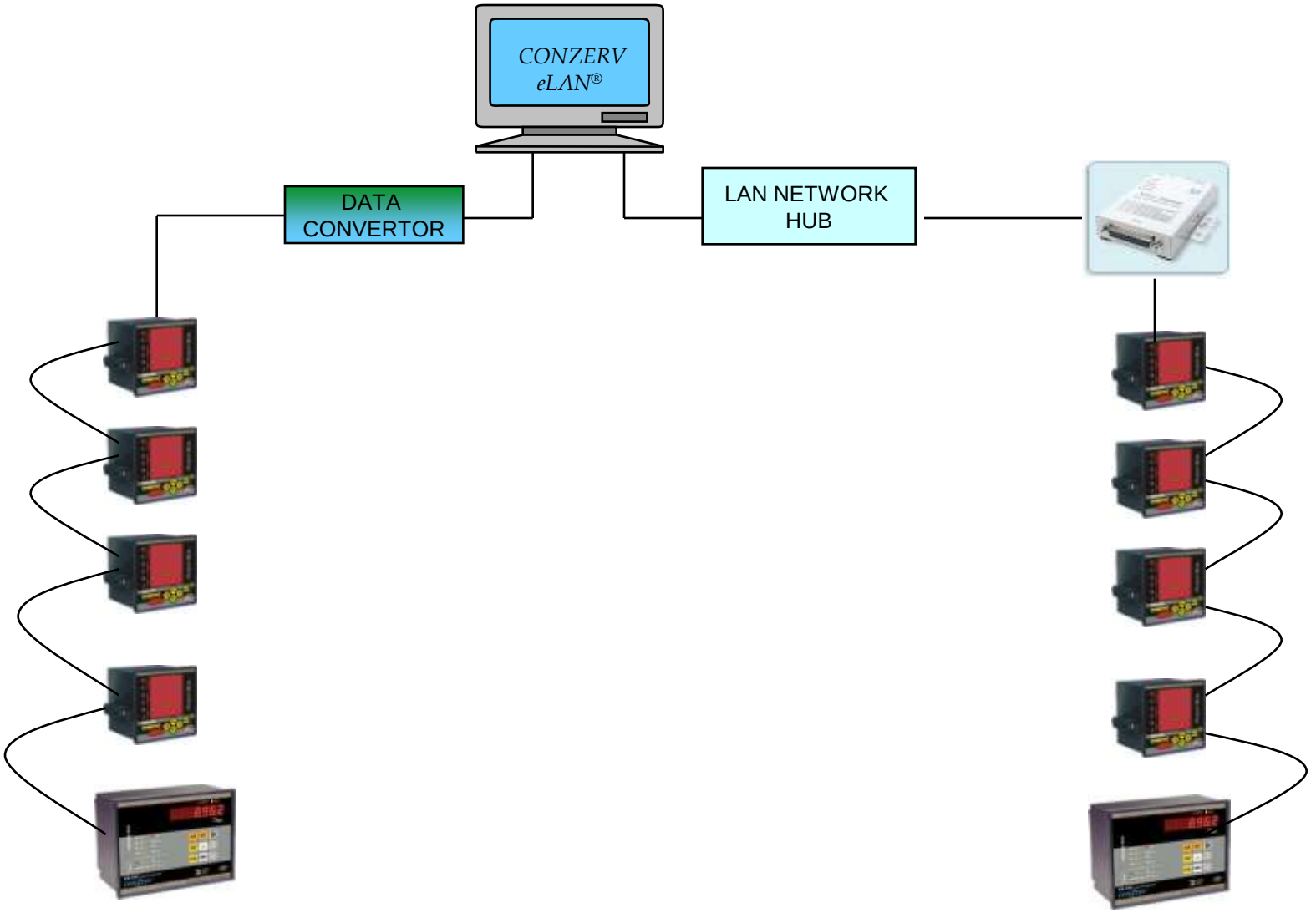
- Meters to be installed for all consumers on supply panel usually located in Facility Manager’s area.
- All common areas, elevators, lifts etc to be separately monitored.
- Energy balancing and reconciliation between EB supply and consumer billing to be carried out daily.

Instrumentation for Measurement

Stand-Alone Meters are not enough

- Generally provide only Raw Data
- Readings cannot be correlated on-line, in Real-Time
- Difficult to relate Energy Consumption to actual usage of facility
- Optimisation requires On-Line Data. Difficult to achieve with Stand-Alone Instruments.

Energy Management & Billing System




EM 6000 Series


EM 3000 Series


ETHERNET
CONVERTOR

DATA
CONVERTOR
RS 485-
RS232
CONVERTOR

EBS Benefits

- Automated billing
  - More accurate billing
  - Root cause analysis for high energy cost.
- Alarms for any abnormalities
- Predictive Maintenance schedule of equipments based on run hours
- Equipment efficiency analysis to make replacement strategies for investments
- Daily energy balancing

EBS Benefits – contd.

- Analysis of energy consumption, cost and energy cost trends
- Data analysis and solutions by an expert feasible
- Can keep check on spillages or wastages in premises and common areas
- Independent check on the equipment energy efficiency
- Reduction in luminaire inventory, replacement cost and energy consumption in lighting

SHOP READING LM - 24 - 1

FEEDER DETAILS	METER READING	M.F.	kWHr
PVR CHILLER 9TH FLR	397507.00	1.00	397501.00
SPARE1	397507.00	1.00	397488.00
SPARE2	397497.00	1.00	397488.00
EXALATOR PANEL	399621.00	1.00	397249.00
LIGHTING PANEL	452084.00	1.00	397311.00
BIG BAZAR AC-1	312582.00	1.00	296140.00
DG AUX PANEL	397773.00	1.00	397378.00
BIG BAZAR AC2	429525.00	1.00	396763.00
PROZONE 3RD FLR	575671.00	1.00	575658.00
OUTER SIGN PANEL	576261.00	1.00	575469.00
SEC URITY PANEL	576259.00	1.00	575663.00
SPARE3	8664.00	1.00	4.00

FEEDER DETAILS	METER READING	M.F.	kWHr
STP PANEL	7201.00	1.00	5.00
SPARE4	6.00	1.00	6.00
PANTHALOON GRD	61303.00	1.00	7.00
FLUSHING PANEL	30.00	1.00	8.00
SPARE5	21.00	1.00	9.00
FOURTH-FLR-PANEL	27.00	1.00	10.00
SPARE6	33.00	1.00	11.00
2ND FLR PANEL	42079.00	1.00	12.00
3RD FLR PANEL	38293.00	1.00	13.00
WATER SYS PANEL	13669.00	1.00	14.00
SPARE7	30.00	1.00	16.00
BIG BAZAR LIGHT1	100443.00	1.00	17.00

OP READING LM24 - 1
SHOP READING LM24 - 2
SHOP READING LM24 - 8
COMM STATUS
HISTORY
OP READING LM24 - 3
SHOP READING LM24 - 4
MIMIC
USER MANUAL
HOME PAGE
OP READING LM24 - 5
SHOP READING LM24 - 6
SHOP READING LM24 - 7
REPORTS
LOG ON
EXIT eLAN

15 13

ENERCON
Enercon Systems Pvt Ltd

HILTON HOTEL, ABU DHABI

ALARM CURRENT STATUS 2

PREV NEXT

NODE	TYPE	VALUE	LOW	HIGH	STATUS	LAST OCCURED AT
CHILLER NO 3	KVA	498	530	550		
	KW	414	500	550		
	A	701	34	33		
	PF	0.83	0.80	0.90		25/05/2004 21:06:00
	VLL	410	55	66		
	VLN	237	66	55		
CHILLER NO 8A	KVA	0	343	45		
	KW	0	45	34		
	A	0	30	343		
	PF	0.00	0.40	0.50		
	VLL	420	79	77		
	VLN	243	77	77		
BEACH RESORT CLUB (WED)	KVA	0	34	45		
	KW	0	34	45		
	A	0	30	55		
	PF	0.00	0.20	2.34		
	VLL	0	90	88		
	VLN	0	99	88		

NODE	TYPE	VALUE	LOW	HIGH	STATUS	LAST OCCURED AT
CHILLER NO 4	KVA	0	334	45		
	KW	0	44	445		
	A	0	33	334		
	PF	0.00	-0.90	-0.70		
	VLL	421	55	55		
	VLN	243	5	5		
O/W TRF'MER NO 2 ELEC A	KVA	29	35	33		
	KW	25	33	455		
	A	40	33	22		
	PF	0.86	-0.10	0.09		25/05/2004 20:02:12
	VLL	425	78	8		
	VLN	246	8	9		
BEACH CHILLER NO 1	KVA	143	455	33		
	KW	101	33	34		
	A	198	22	44		
	PF	0.70	0.09	1.00		
	VLL	418	80	80		
	VLN	242	77	89		

MAIN | MATRIX | HISTORY | VIEW REPORTS | HELP

METER DATA | SLD | ALARMS SET | NODE STATUS | LOGIN

REAL TREND | CREATE REPORTS | UTILITIES | ALARM VIEW | CLOSE

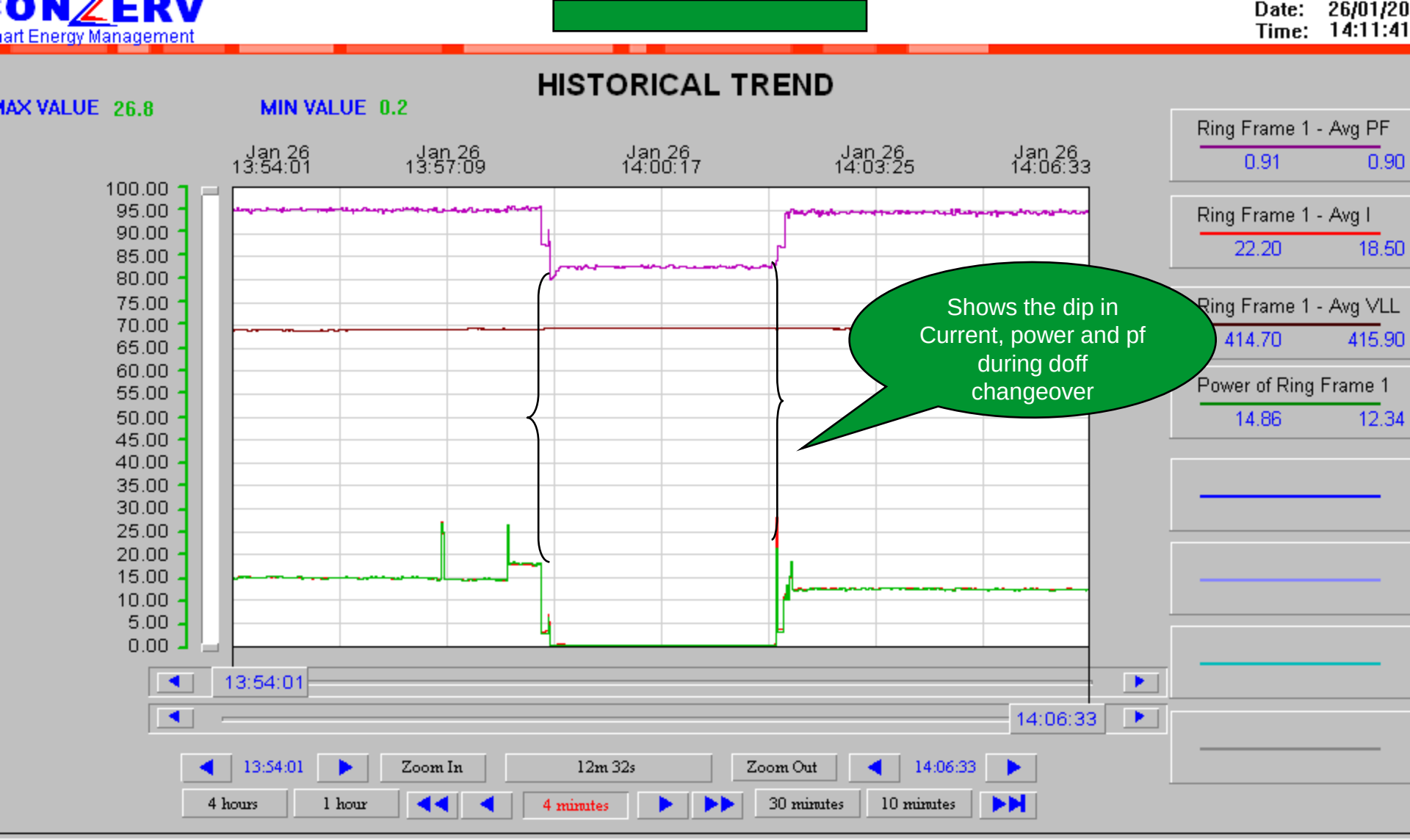
Explorer OPEN
Modbus OPEN
Excel CLOSE

Max Min Report of VLL, Amps, kW & PF - Hourly wise with Time of Occurrence

Date: 20/02/2006

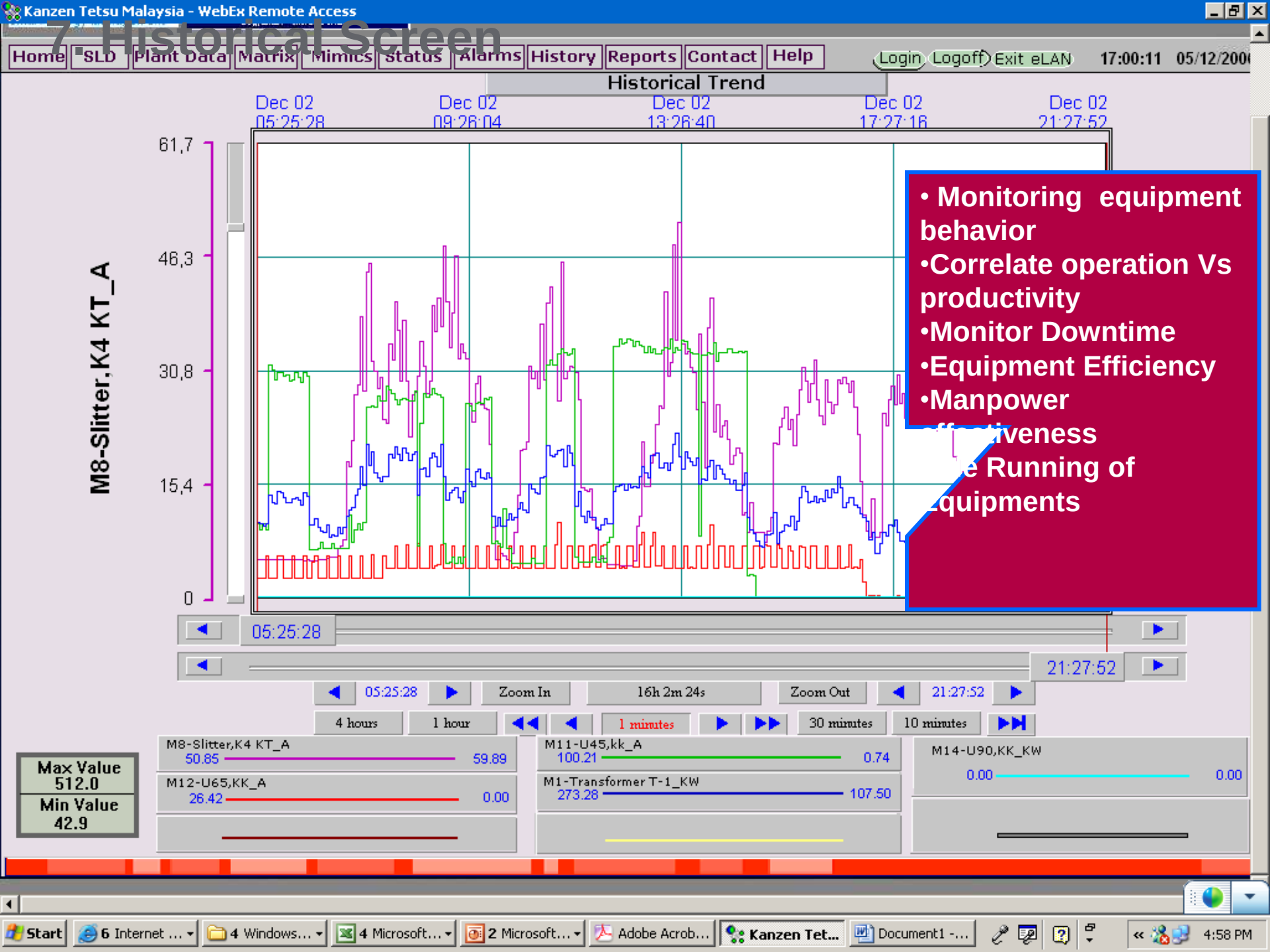
Feeder name		Pump No.1	Pump No.2	Pump No.3	Pump No.4	Pump No.5	Pump No.6	Pump No.7	Pump No.8	F.S 1	F.S 2	F.S 3	F.S 4
Voltage - LL	max	0	3395.537	3394.768	3394.939	3405.845	3405.842	3408.068	3407.827	3369.749	3373.4	3371.475	3374.7
		00:05:00	01:00:00	01:00:00	01:00:00	01:00:00	01:00:00	01:00:00	01:00:00	00:55:00	00:55:00	00:55:00	00:55
	Min	0	3338.001	3337.357	3337.057	3348.387	3348.024	3350.132	3350.277	3328.445	3331.23	3329.537	3332.6
		01:00:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05
CURRENT	Max	0	143.0988	150.565	2.5E-17	2.5E-17	5E-17	164.6573	194.6063	193.7987	194.0418	206.2328	194.1
		00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05
	Min	0	133.3767	144.3189	2.5E-17	2.5E-17	5E-17	155.5608	182.9423	184.141	184.0738	195.9671	184.1
		01:00:00	00:55:00	00:30:00	00:05:00	00:05:00	00:05:00	00:45:00	00:40:00	00:55:00	00:55:00	00:55:00	00:55
KW	Max	0	813.3397	869.3724	7.5E-19	7.5E-19	1.5E-18	949.2838	1115.041	1089.223	1104.452	1172.426	1098.8
		00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05:00	00:05
	Min	0	767.8888	834.5871	7.5E-19	7.5E-19	1.5E-18	903.6476	1060.774	1050.255	1063.476	1126.177	1053.0
		01:00:00	00:55:00	00:30:00	00:05:00	00:05:00	00:05:00	00:40:00	00:30:00	00:55:00	00:55:00	00:55:00	00:55
PF - lag	Max	0.000	0.985	0.998	0.000	0.000	0.000	0.993	0.988	0.976	0.988	0.987	0.9
		00:05:00	00:35:00	00:05:00	00:05:00	00:05:00	00:05:00	01:00:00	00:40:00	00:55:00	00:55:00	00:50:00	00:05
	Min	0.000	0.981	0.990	0.000	0.000	0.000	0.988	0.983	0.971	0.983	0.983	0.9
		01:00:00	00:25:00	01:00:00	00:05:00	00:05:00	00:05:00	00:25:00	00:25:00	00:25:00	00:25:00	00:10:00	00:40
Voltage - LL	Max	0	3405.15	3404.874	3404.484	3415.488	3415.43	3417.158	3417.324	3351.626	3354.689	3352.8	3356.3
		01:05:00	01:15:00	01:15:00	01:15:00				01:15:00	01:15:00	01:15:00	01:15:00	01:15
	Min	0	3390.626	3390.027	3390.109	34			3405.057	3337.083	3340.632	3338.448	3341.6
		02:0											01:10
CURRENT	Max												194.2
		01:0											02:00
	Min	0	129.7282	142.931	2.5E-17	2.5E-17	5E-17	153.7565	179.9583	184.4271	184.2615	196.5299	184.8
		02:00:00	01:35:00	01:45:00	01:05:00	01:05:00	01:05:00	01:35:00	01:35:00	01:35:00	01:35:00	01:35:00	01:35
KW	Max	0	805.6874	874.2569	7.5E-19	7.5E-19	1.5E-18	955.9848	1111.471	1097.157	1109.255	1174.444	1100.3
		01:05:00	02:00:00	02:00:00	01:05:00	01:05:00	01:05:00	02:00:00	02:00:00	02:00:00	02:00:00	02:00:00	02:00
	Min	0	751.9826	838.2083	7.5E-19	7.5E-19	1.5E-18	901.5816	1050.087	1039.471	1054.926	1123.259	1050.7
		02:00:00	01:35:00	01:10:00	01:05:00	01:05:00	01:05:00	01:35:00	01:35:00	01:35:00	01:35:00	01:35:00	01:35
PF - lag	Max	0.0000	0.9869	0.9974	0.0000	0.0000	0.0000	0.9946	0.9895	0.9760	0.9887	0.9858	0.98
		01:05:00	01:10:00	01:35:00	01:05:00	01:05:00	01:05:00	01:15:00	01:05:00	01:10:00	01:50:00	01:25:00	01:10

MAX & MIN OF VITAL PARAMETERS WITH DATE AND TIME OF OCCURRENCE – PER HOUR BASIS

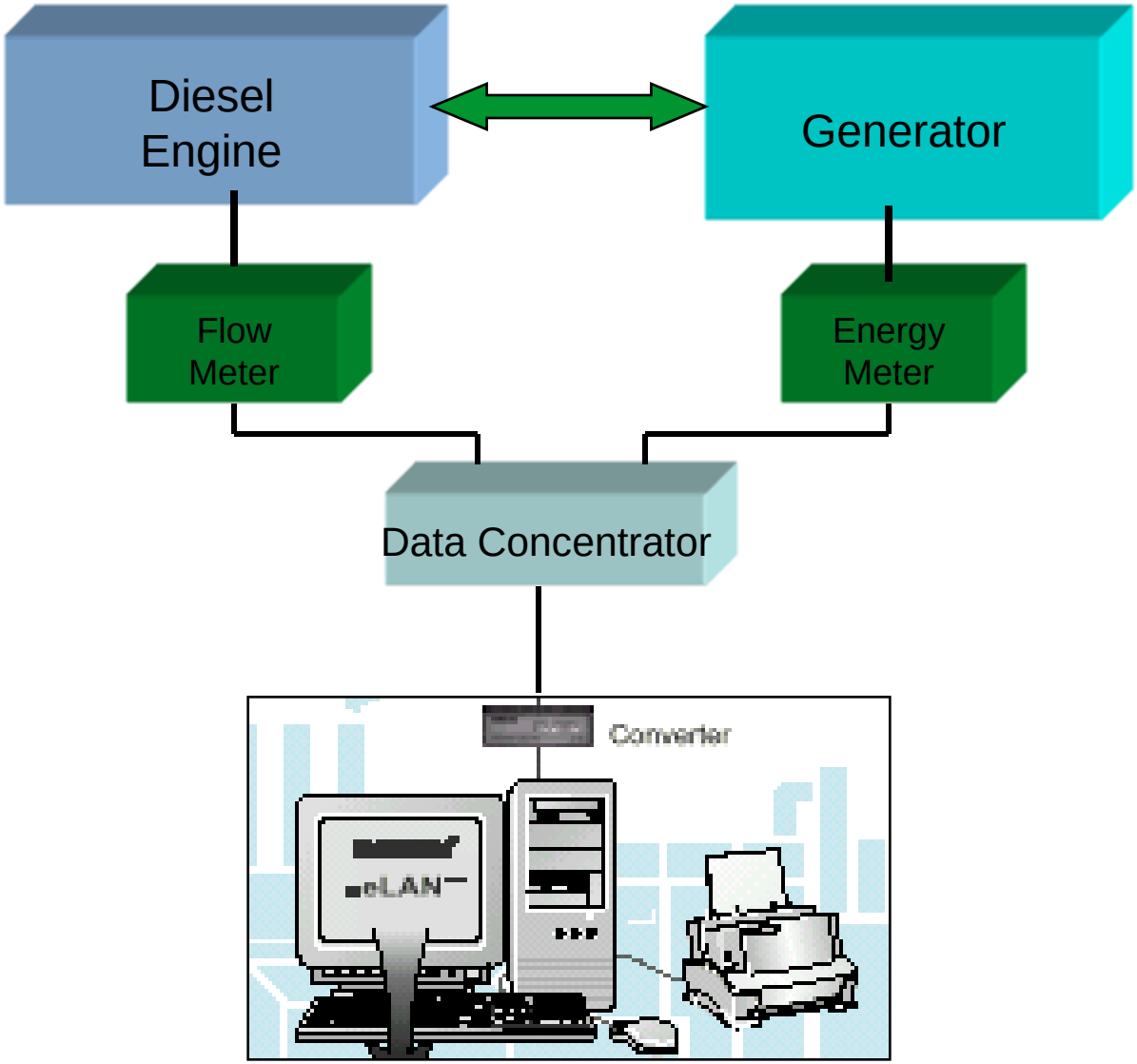


- Doffing changeover duration – keep minimum to increase productivity
- To benchmark the ideal cycle time

7. Historical Screen



Generator Optimisation



Generator Optimisation

- On line data of diesel consumed and units generated.
- Any deterioration in efficiency will be immediately seen.
- Average should be 3.5 units per liter or better.
- Generator can be efficiently operated and maintained

Lighting

Best Operating Practices in Lighting

- Upgrade Lighting technologies
- Daylight harvesting
- Energy management in lighting controls
- Occupancy sensors
- Optimizing Voltage in lighting circuit

Luminous Performance Characteristics of Commonly Used Luminaries

Type of Lamp	Lum / Watt		Color Rendering Index	Typical Application	Life (Hours)
	Range	Avg.			
Incandescent	8-18	14	Excellent	Homes, restaurants, general lighting, emergency lighting	1000
Fluorescent Lamps	46-60	50	Good w.r.t. coating	Offices, shops, hospitals, homes	5000
Compact fluorescent lamps (CFL)	40-70	60	Very good	Hotels, shops, homes, offices	8000-10000
High pressure mercury (HPMV)	44-57	50	Fair	General lighting in factories, garages, car parking, flood lighting	5000
Halogen lamps	18-24	20	Excellent	Display, flood lighting, stadium exhibition grounds, construction areas	2000-4000
High pressure sodium (HPSV) SON	67-121	90	Fair	General lighting in factories, ware houses, street lighting	6000-12000
Low pressure sodium (LPSV) SOX	101-175	150	Poor	Roadways, tunnels, canals, street lighting	6000-12000

Lighting Energy Saver Features

% Savings, One Time Setting

20% Tech parks
OLTC / UPS Stabilized Supply
PFC Ballasts, New Lamps

15% General Use
Malls, Offices, Multiplexes, Auditoriums
OLTC Stabilized
Mixed Old / New Lamps

10% Buildings older than 5 yrs
Supply goes down to 200v occasionally
Very Old Fluorescents

Bypass – Supply < 200v

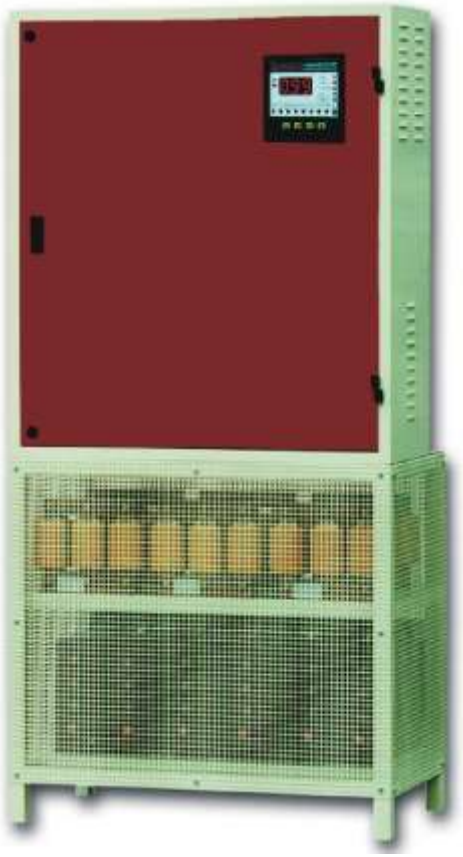
Savings Spot Check
Factory Option Meter

Short circuit,
Over load protection

Electronic Line Monitor
Lo, OK, Hi voltage and Trip
with Alarm Relay o/p

Power Factor Improvement Panel

- Compact modular stand alone unit
- Comprises of capacitors,
  Contactors/Thyristors, isolating switch,
  HRC fuses, Power factor Controller
- Models from 35kVAR to
  1200kVAR



Demand Controller

- TOU Demand Control & Energy Monitor
- User Programmable Upper Limit, Lower Limit,
- Essential Load and Prediction Interval for sophisticated Demand Control
- Demand Control through Unique Predictive technique and Sliding Window Integration Lea Reduced Energy Losses, Improved Load Fact
- Minimal disruption in operations
- 3 Change Over Potential free control outputs for: Predicted Demand exceeding Target, Demand exceeds Target & Restore Load

Air-conditioning

Air-conditioning

The cooling effect produced is quantified as tons of refrigeration.

1 ton of refrigeration = 3024 kCal/hr heat rejected.

Energy Use Standards

- The available norms of energy use in hotel industry are follows:-

- Power - 60 – 75 kWh/day/room
- Fuel - 4 – 5 Liters/day/room
- Water - 1.15 – 1.3 KL/day/room

BEE has recently announced the Building Codes.

Types of Compressors

- Centrifugal compressors
- Reciprocating compressors
- Screw Compressors
- Vapour absorption chillers

Effect of Poor Maintenance on Compressor Power Consumption

Condition	Evap. Temp (^{0}C)	Cond. Temp (^{0}C)	Refrigeration Capacity (tons)	Specific Power Consumption (kW/ton)	Increase in kW/Ton (%)
Normal	7.2	40.5	17.0	0.69	-
Dirty condenser	7.2	46.1	15.6	0.84	20.4
Dirty evaporator	1.7	40.5	13.8	0.82	18.3
Dirty condenser and evaporator	1.7	46.1	12.7	0.96	38.7

Energy Performance – Down Side Equipments

- Chilled Water Pump - 0.10 – 0.12 kW/TR
- Condenser Water - 0.085 – 0.12 kW/TR
- Cooling Tower - 0.03 – 0.1 kW/TR
- AHU - 3000 – 6000 CFM/kW
- FCU - 8000 - 10000 CFM/kW

ENERGY SAVINGS OPPORTUNITIES

- ***Cold Insulation***
- Thumb rules for cold Insulation
  - Chilled water pipe insulation (Provide 2 to 3 inch thickness)
  - Duct insulation (Provide 1 to 2 inch thickness)
  - Suction line refrigerant pipe insulation (Provide 2 to3 inch thickness)

- ***Building Envelop***
- ***Building Heat Loads***
- ***Process Heat Loads Minimization***
  - Flow optimization and Heat transfer area increase to accept higher temperature coolant
  - Avoiding wastages like heat gains, loss of chilled water, idle flows
  - Frequent cleaning / de-scaling of all heat exchangers

Energy Saving Opportunities

- Comfort conditions: 25^{O}C, 55 % RH
- Minimize heat load through glass windows
  - Provide sun control film, Use double glass
- Insulate roof top in A/C Building
  - Provide under deck insulation of 50 mm, Provide lawns at roof top
- Optimize fresh air supply into a/c room
  - Conduct CO_2 study to optimize fresh air quantity
  - 10-15 cfm/person or 0.25 cfm/sq..ft as per ASHRAE
- Minimise artificial lighting
  - Use natural lighting , 3.5 kw lighting consumes 1.0 TR load
- Provide controls
  - install thermostat to control peak and base load
  - Provide VSD for AHU with return air temp.sensor-set at 25^{o}C
- Air tight the building envelop
  - prevent cold air leakage, Provide door closures
- Avoid heat producing equipments inside the room
  - keep away UPS Battery , ovens, other loads

Solutions for Efficiency in Air Conditioning

- Energy Audit can indicate where efficiency is low or where energy consumption is excessive. It will also assess losses and wastages in the system.
- EMS can provide running efficiency of the system by monitoring energy efficiency of chillers and other components on a continuous basis.
- BMS can control HVAC to provide maximum efficiency without compromising comfort conditions

Case Studies

PF in a Building

Energy Billing in Software Park

Office Building

- A large office building
- Two transformers and two LT panels
- APFC relays installed with both panels
- Still average monthly power factor was as low as 0.79
- Heavy LPF penalty of as high as Rs 2.4 lakhs per month

Office Building

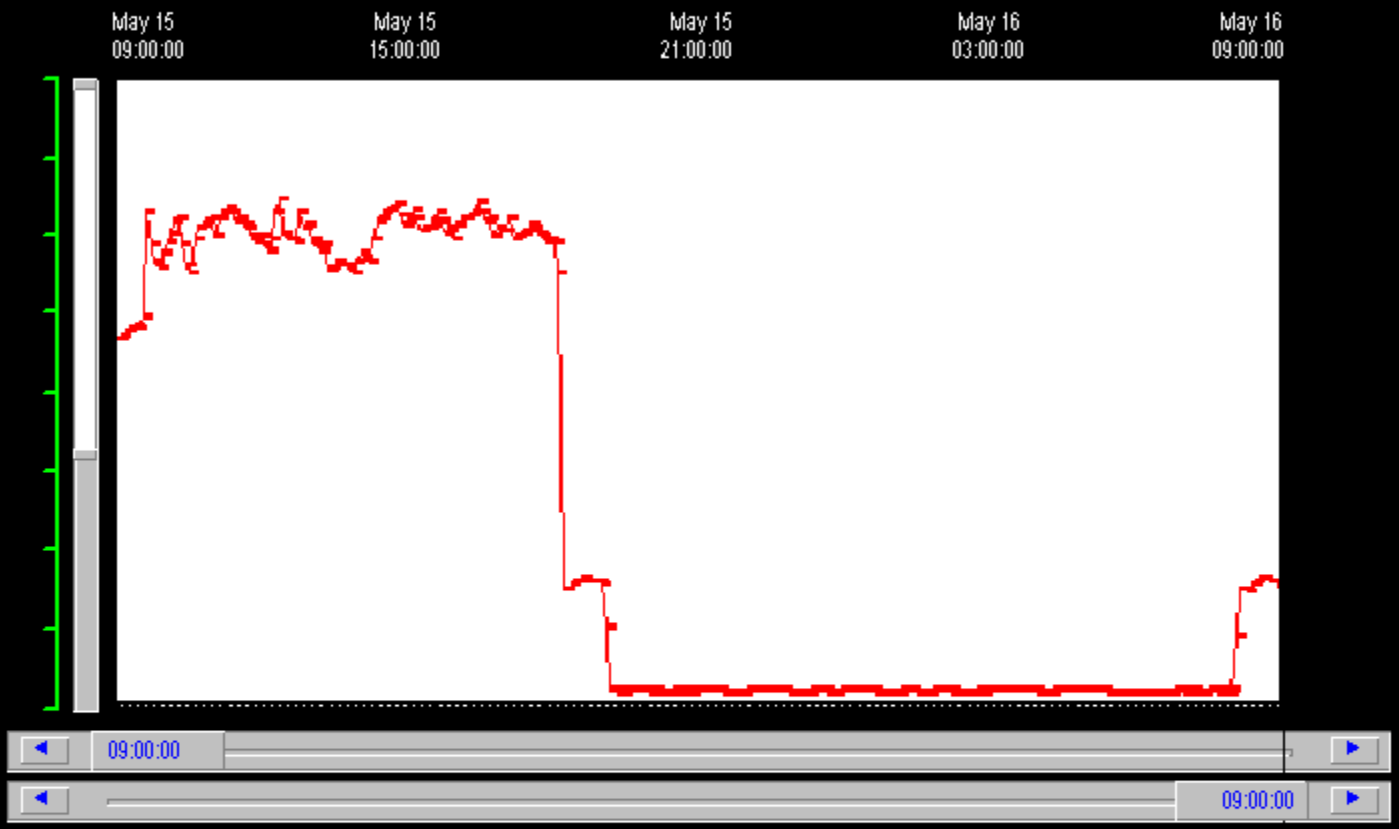
- Examined performance of all capacitors, replaced damaged ones
- Added more capacitors in the circuit
- The relays were checked suspecting malfunctioning
- Approached the EB suspecting fault in the electronic meter

Office Building

- The overall power factor remained at about 0.8 after all these efforts
- Finally, the department decided to equip the building with eLAN and called in Conzerv

ENERCON®
Enercon Systems Pvt Ltd

HISTORICAL TRENDS



09:00:00 | Zoom In | 1d | Zoom Out | 09:00:00

4 hours | 1 hour | Minutes | 30 minutes | 10 minutes

ZOOM

Help | Mimics | Real Time Trends | Historical Trends | Alarms | Reports | Print

Office Building

- The load pattern as recorded by eLAN indicated kW loading as low as 15 kW after office hours, about 14 hours per day
- Same load pattern during Saturdays, Sundays and Holidays
- Decided to check the PF profile

Office Building

- The installed capacitors were all 25 kVAR rating each
- Due to low load none of the capacitors were getting switched on
- Replaced the capacitors with lower rating of 10 kVAR each
- Relays started switching on capacitors
- Power factor improved to above 0.95
- Resulted in annual saving of Rs. 28.8 lakhs per annum

Case Studies - 2

Hospital

Observations

- **Main Incomer**
  - Load varies between 450 kVA (Night) and 1800 kVA (Day)
  - Day time PF varies between 0.93 to 0.96
  - Night time PF varies between -0.33 to -0.99
  - Peak Load is between 10 AM to 3 PM
  - Average energy consumption per day 30,500 kWh (Week days) 25,400 kWh (Sundays)

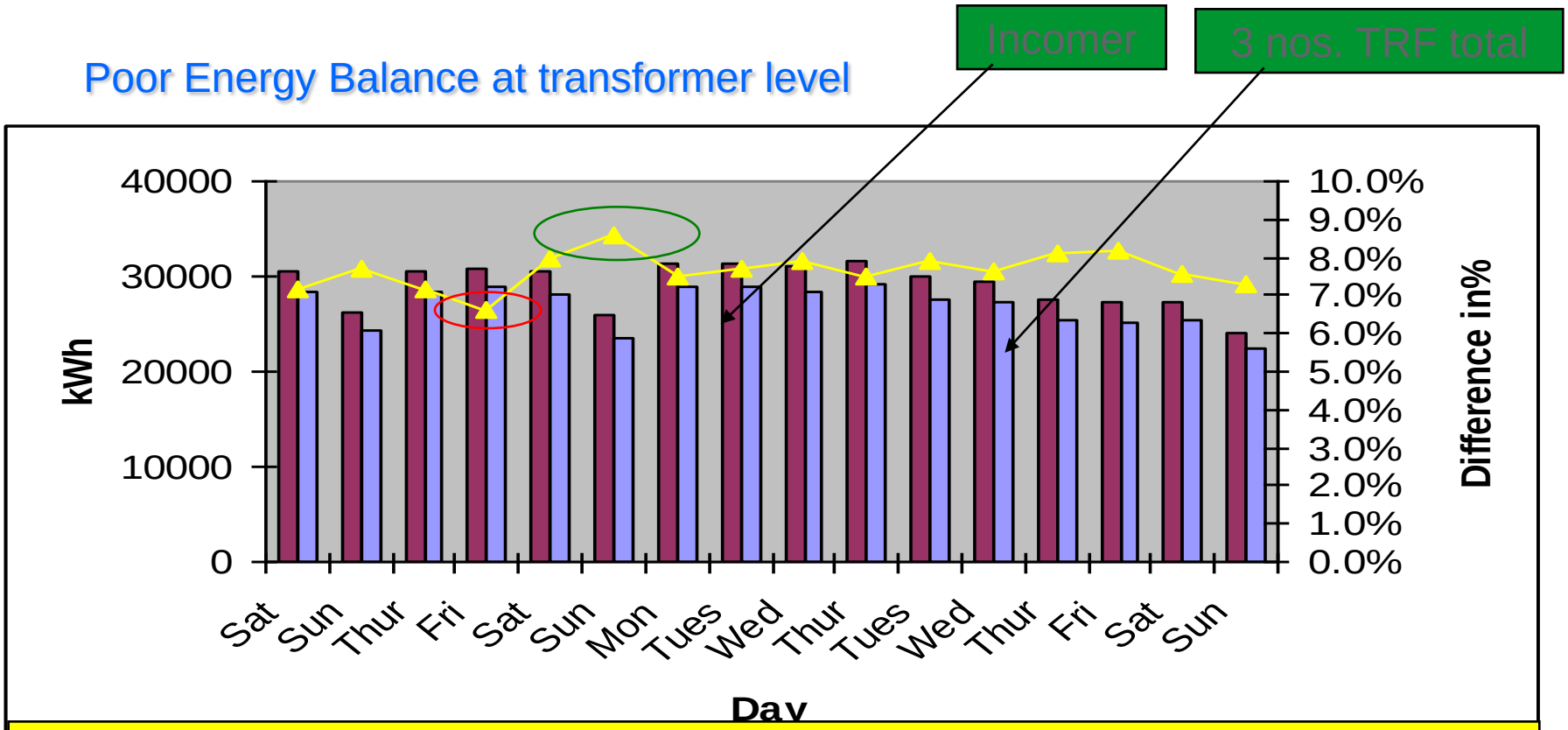
Transformers

TRF No.	Units	1	2	3
Rating	kVA	1000	1000	1600
Power	kW	36 to 378	184 to 381	268 to 775
Load	kVA	175 to 434	190 to 411	274 to 827
PF	PF	-0.16 to -0.91	0.96 to 0.99	0.88 to 097
Loading	%	38%	38%	50%

All 3 Transformers are under loaded

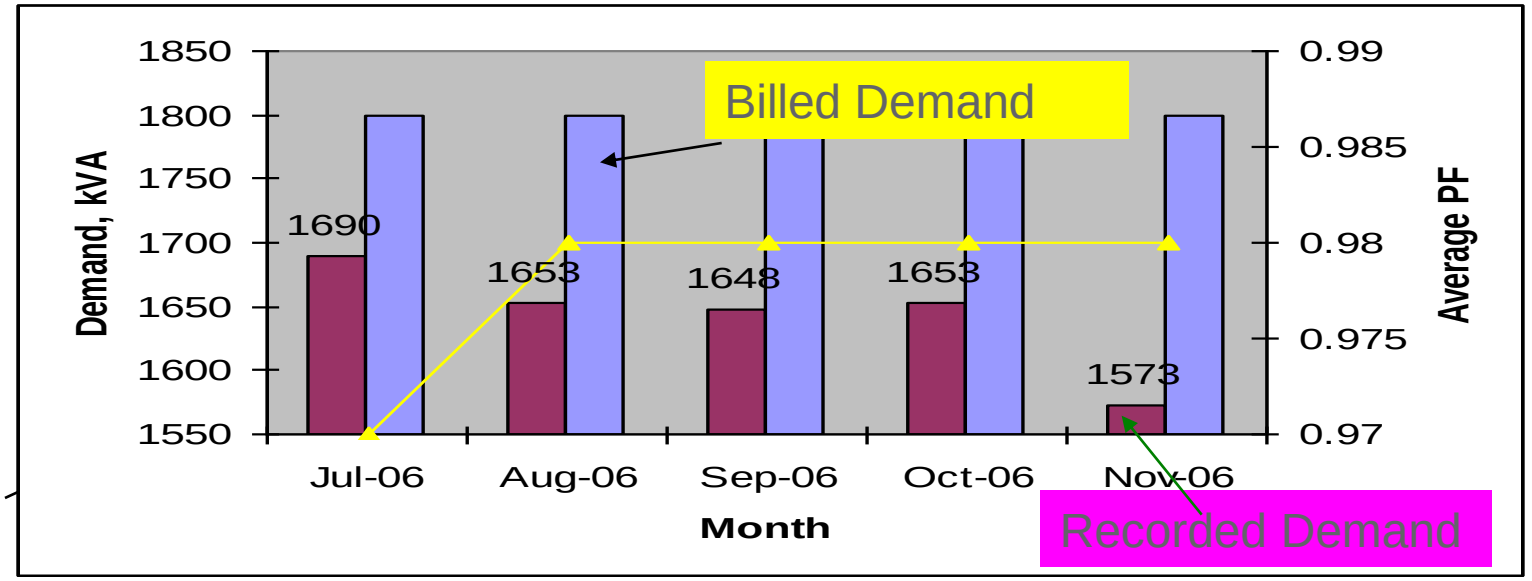
Observations

Poor Energy Balance at transformer level



Distribution Losses (Avg) – 7.7%, ie 2000 kWh*
Improving energy balancing can reduce this by 3%(40% reduction)
800Kwh*Rs5*30Days= Rs 1.20 Lakhs

Power Factor & Demand

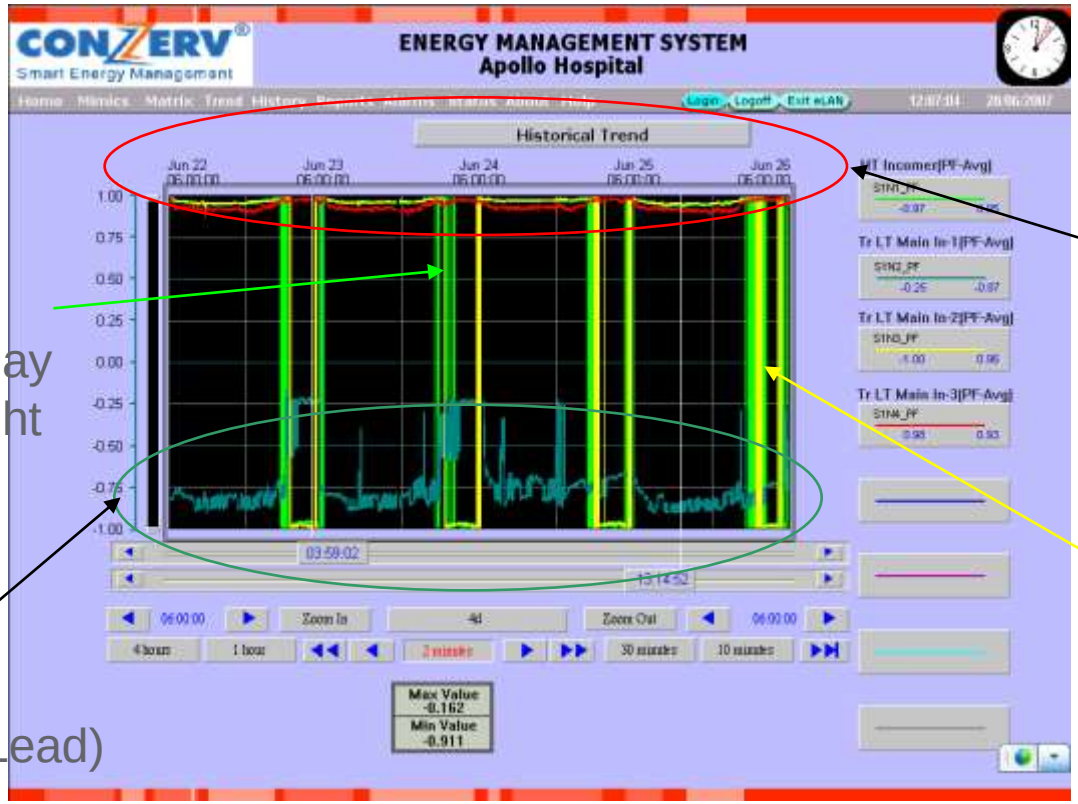


	PF	RD, kVA	Billed, kVA	PF Incentives	Demand charges	Savings/Month
Present	0.975	1648	1800	Rs.40,000(1.5%)	Rs.5.40 lacs	Rs. 1 lac
Proposed	Unity	1610	1620	Rs.83,000(2.5%)	Rs.4.90 lacs	

Contract Demand – 2000 kVA, Billed demand – 90 % of CMD in TN

Good scope to reduce Contract Demand by 10%

Transformer Power Factor Analysis



Incomer
Lag – In Day
Lead - Night

TR -1

(Always Lead)

TR – 3
(Always Lag)

TR – 2

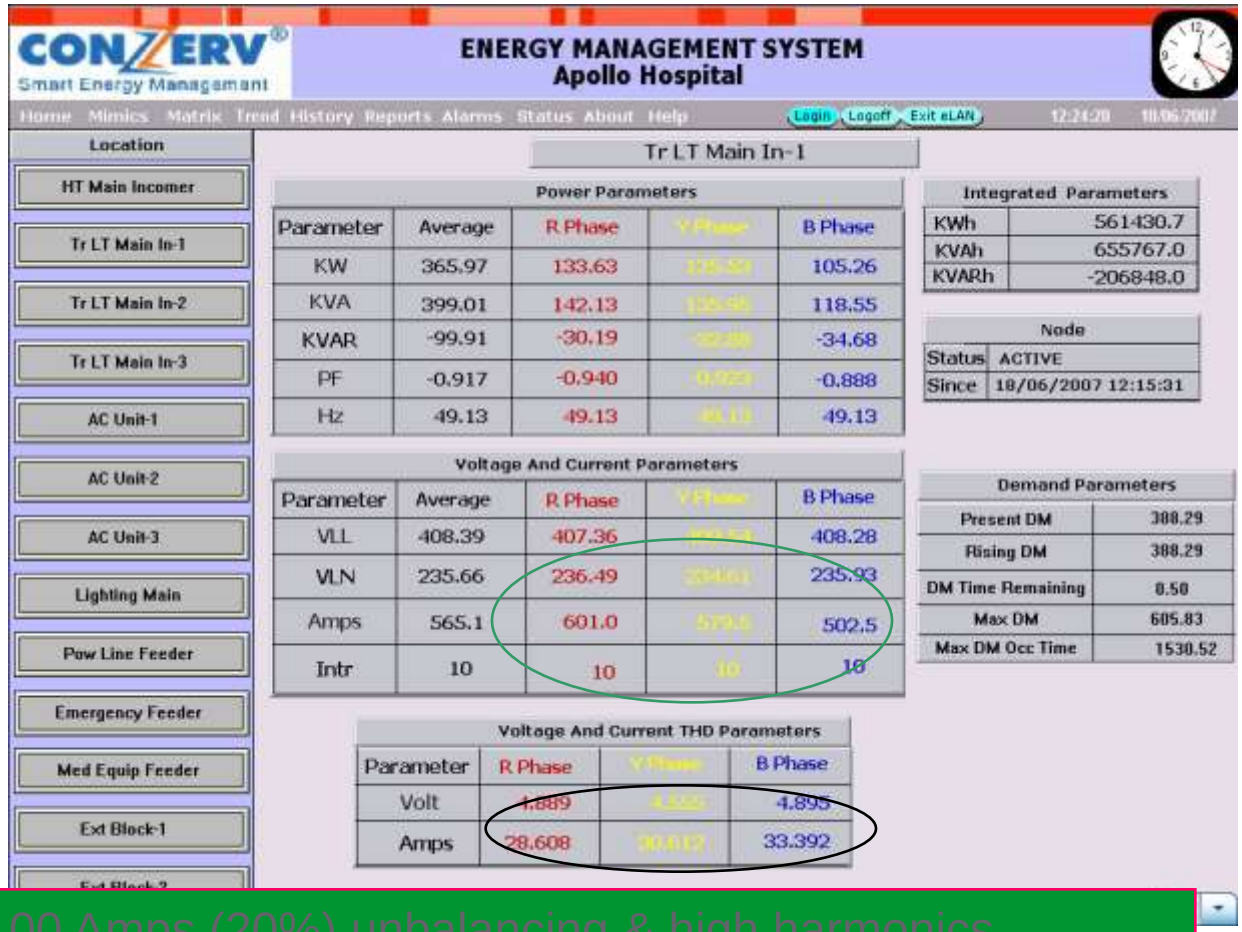
Lag – In Day
Lead - Night

Frequent change in PF (lead and lag) due to malfunctioning of APFC relay.

Observations

- **In Transformer – 1, PF is always leading**
  - Highly capacitive load (300 kVAr)
  - 100 kVAr – APFC (Relay not working)
  - 200 kVAr – Fixed capacitor banks
  - Harmonics I_{THD} 35% and V_{THD} 5%
  - Unbalanced load – 20% (100 amps)
  - Transformer Percentage loading is less (38 %)
  - Scope to reduce the total transformer losses

Transformer – 1 Unbalancing



100 Amps (20%) unbalancing & high harmonics

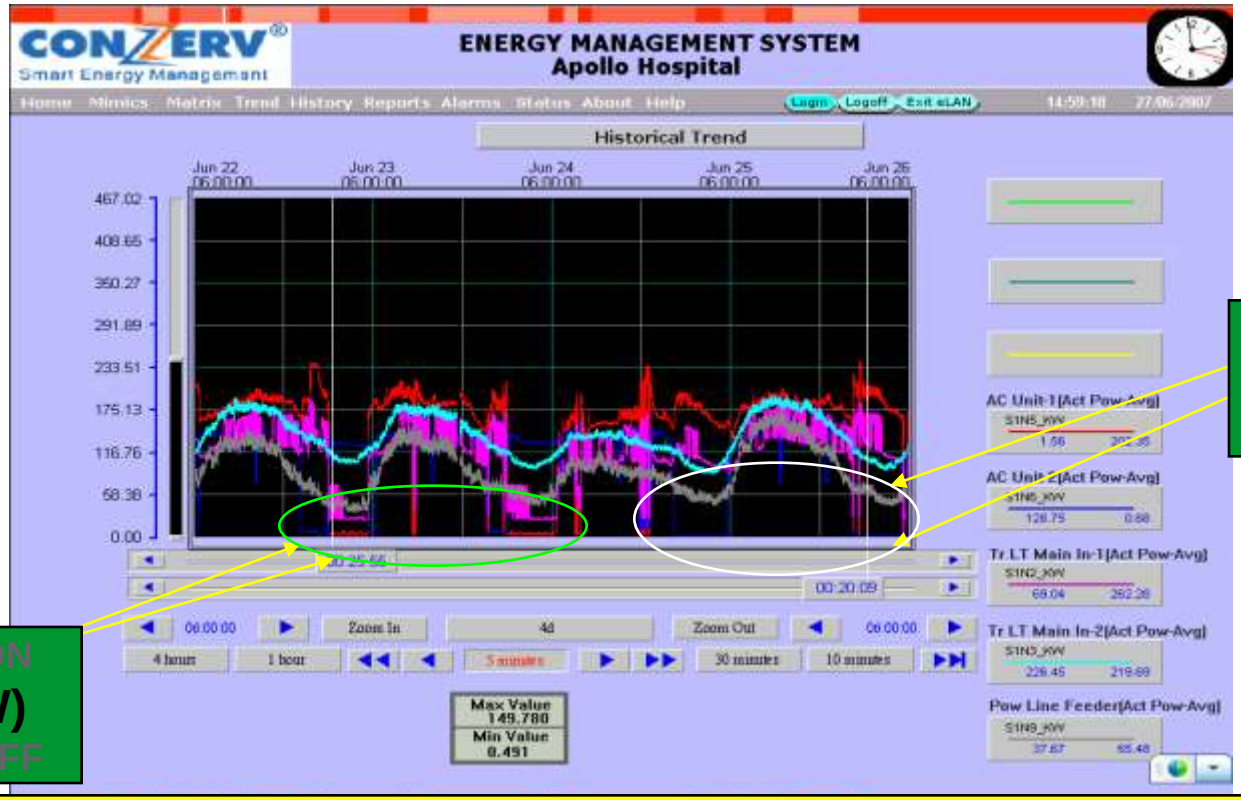
Observations….

- **In Transformer – 2, PF is leading in night**
  - Highly capacitive load (2 X 100 kVAr)
  - One relay is working and another is faulty
  - Transformer Percentage loading is less (38 %)
  - Scope to reduce the total transformer losses
- **In Transformer – 3, PF is lagging**
  - All the capacitors banks are ON in APFC panel
  - Load is Maximum (770 kVA)
  - Additional reactive power is required to reduce the losses
  - Transformer Percentage loading is less (50 %)
  - Scope to reduce the total transformer losses

Observations….

- A/C plant
  - Available
    - 350 TR X 2 (VFD for the compressors), 190 TR X 1 (2 nos. of compressor works ON – OFF control)
    - 350 TR X 1 and 190 TR X 1 is running during day
  - Observation
    - Some time 350 TR X 1 and some time 190 TR X 1 is operated during night time
    - Auxiliary loads (pumps, CT Fans) are running irrespective of the chiller
    - AHUs is running constant irrespective of chiller load
    - No meters in pumps and CT Fans
    - Power factor is always leading (due to 200 kVAr fixed capacitors)

Chillers

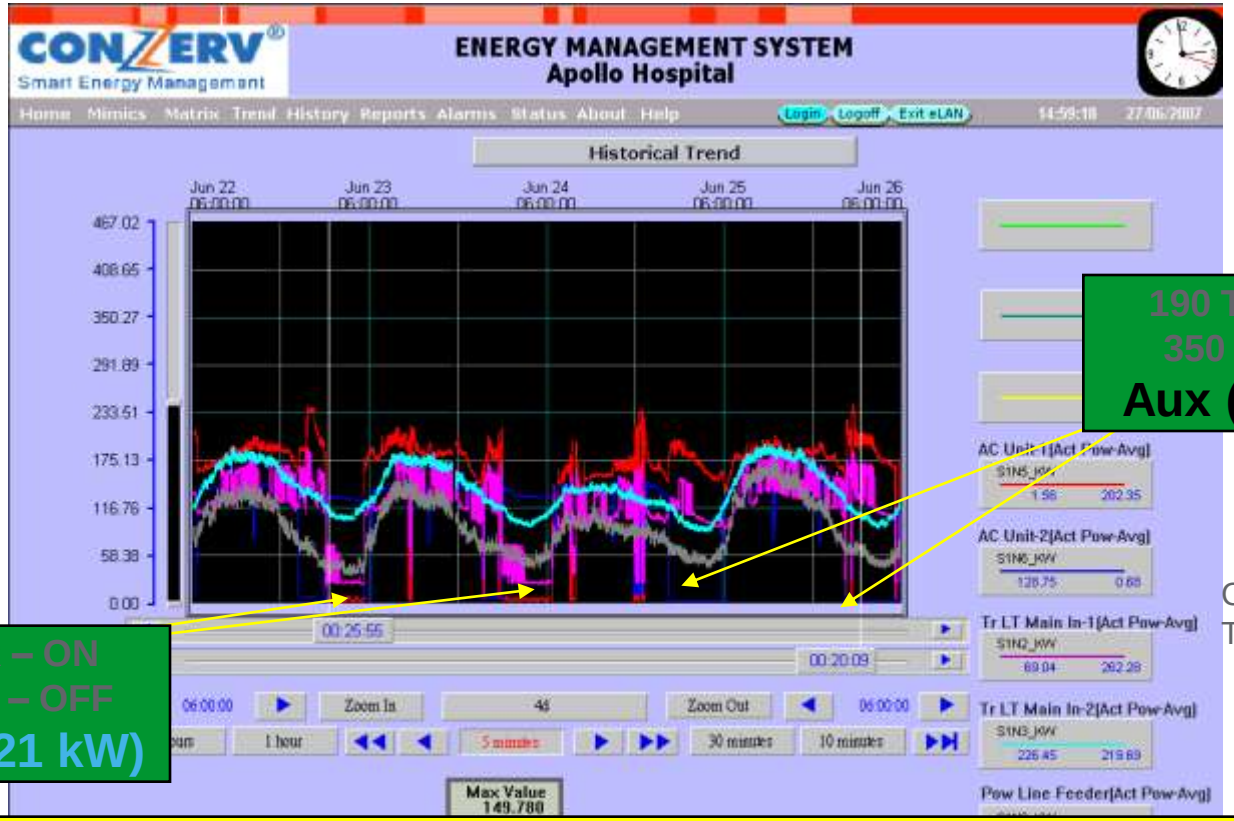


190 TR – ON
(128 kW)
350 TR - OFF

190 TR – OFF
350 TR – ON
(202 kW)

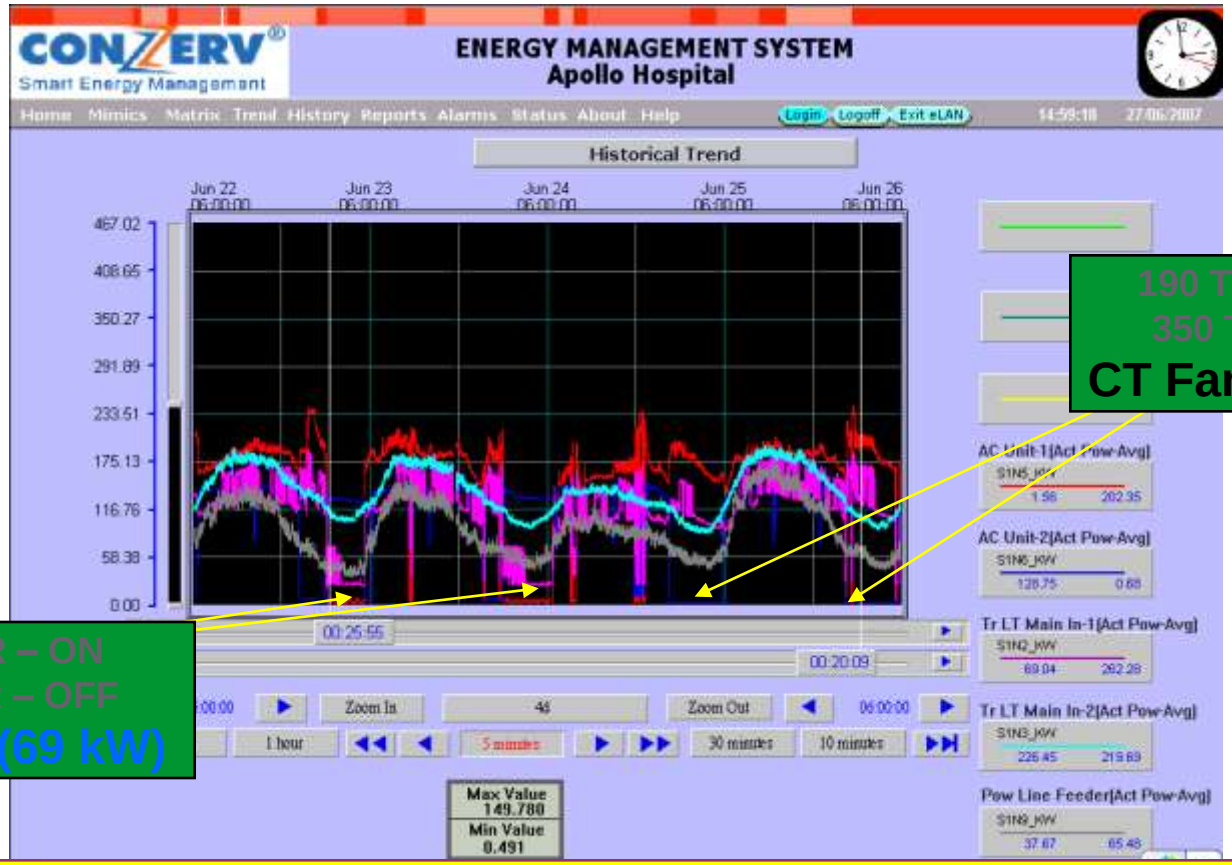
It is observed either 350 TR chiller or 190 TR chiller is running in night. But AHU load is same. Operating 190 TR will reduce the auxiliary power consumption.

Auxiliary Load (Pumps)



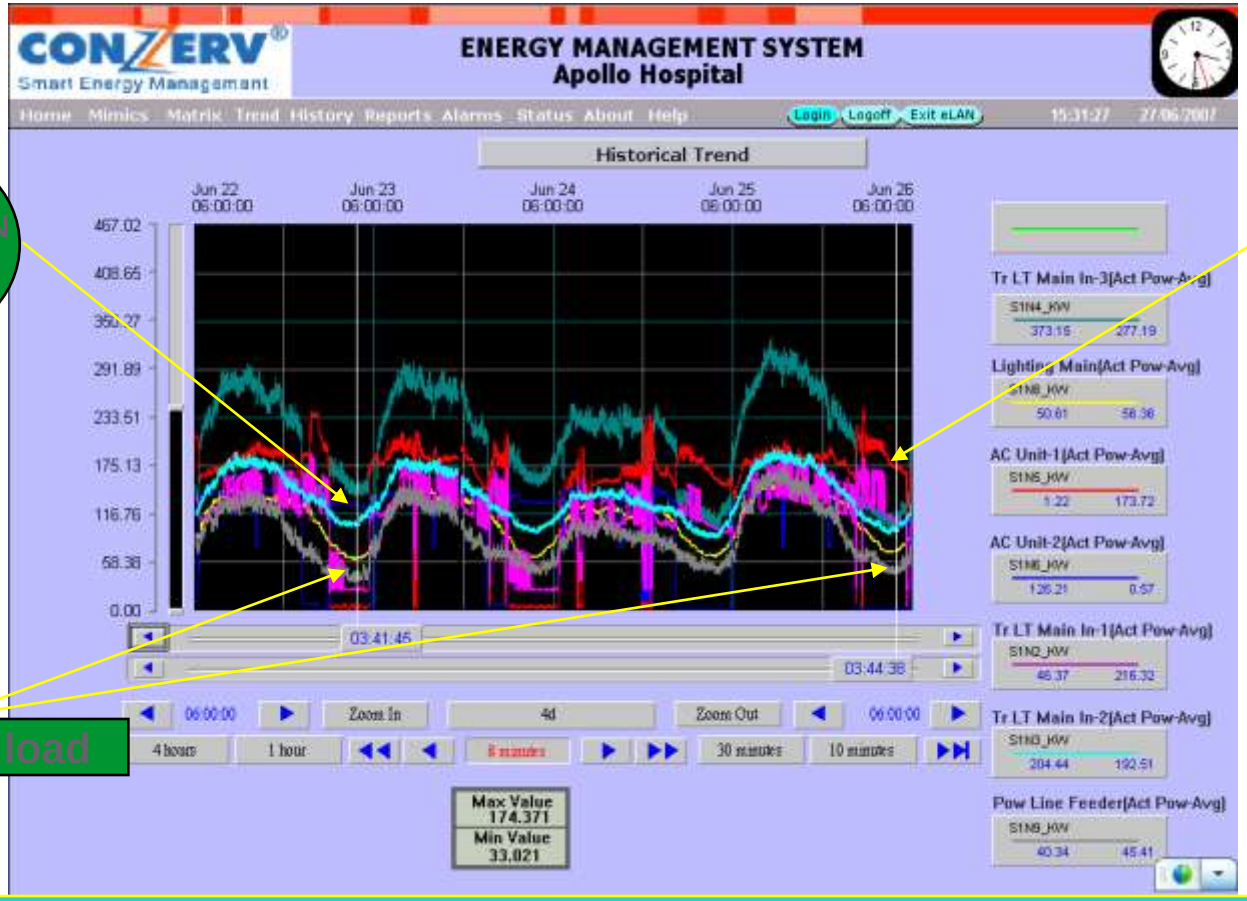
It is observed here pumps (Condenser & Chilled water) of Chillers remaining constant irrespective of 350 TR and 190 TR chiller usage. Possibility of reducing pump load (25 %) based on chiller operation.

Auxiliary Load (Cooling Tower Fan)



Possibility of optimizing auxiliary load (CT fan, pumps) when 190 TR is running. This lead to save (48 kW*7hrs*5*30days= Rs.50,400 per month)

Air Handling Units (AHUs)



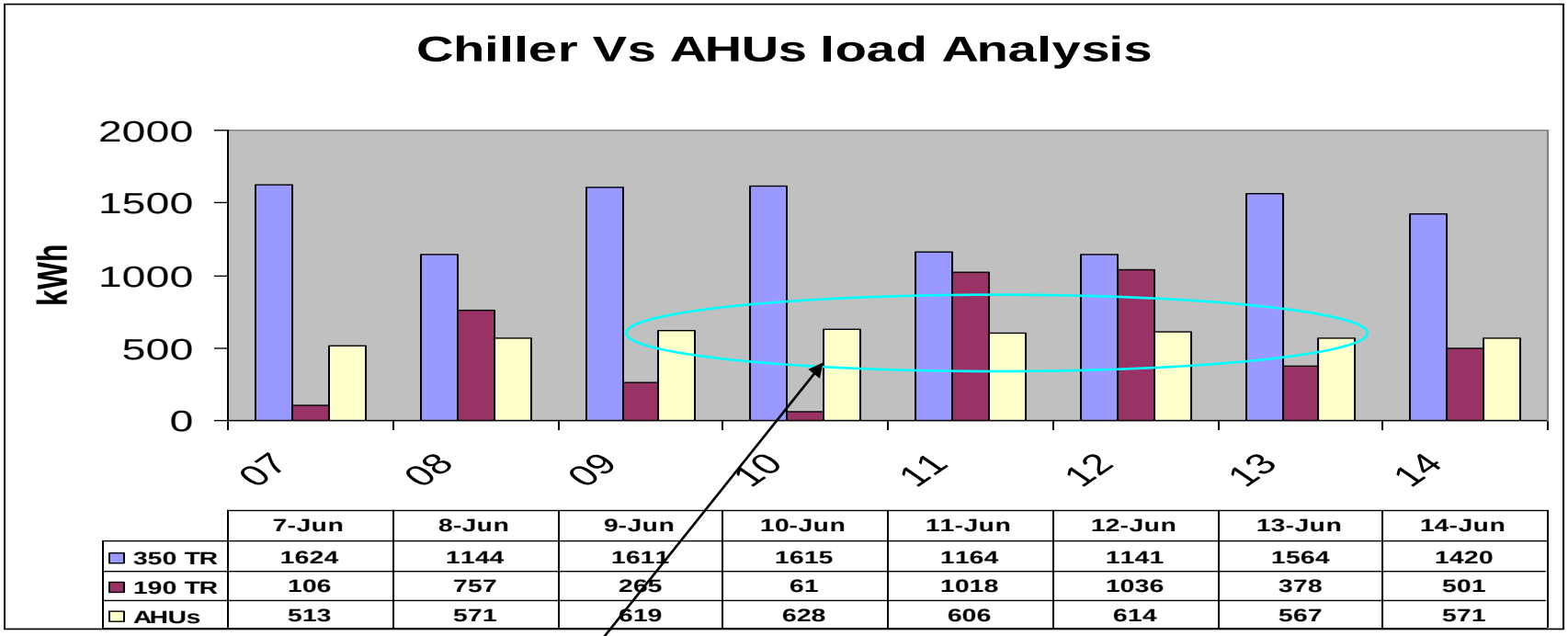
190 TR – ON (126 kW)

350 TR – ON (173 kW)

Same AHU load

AHU load is constant irrespective of chiller load. Control AHU fan based on room temperature. 30% AHU power can be saved. Need to analyze in detail.

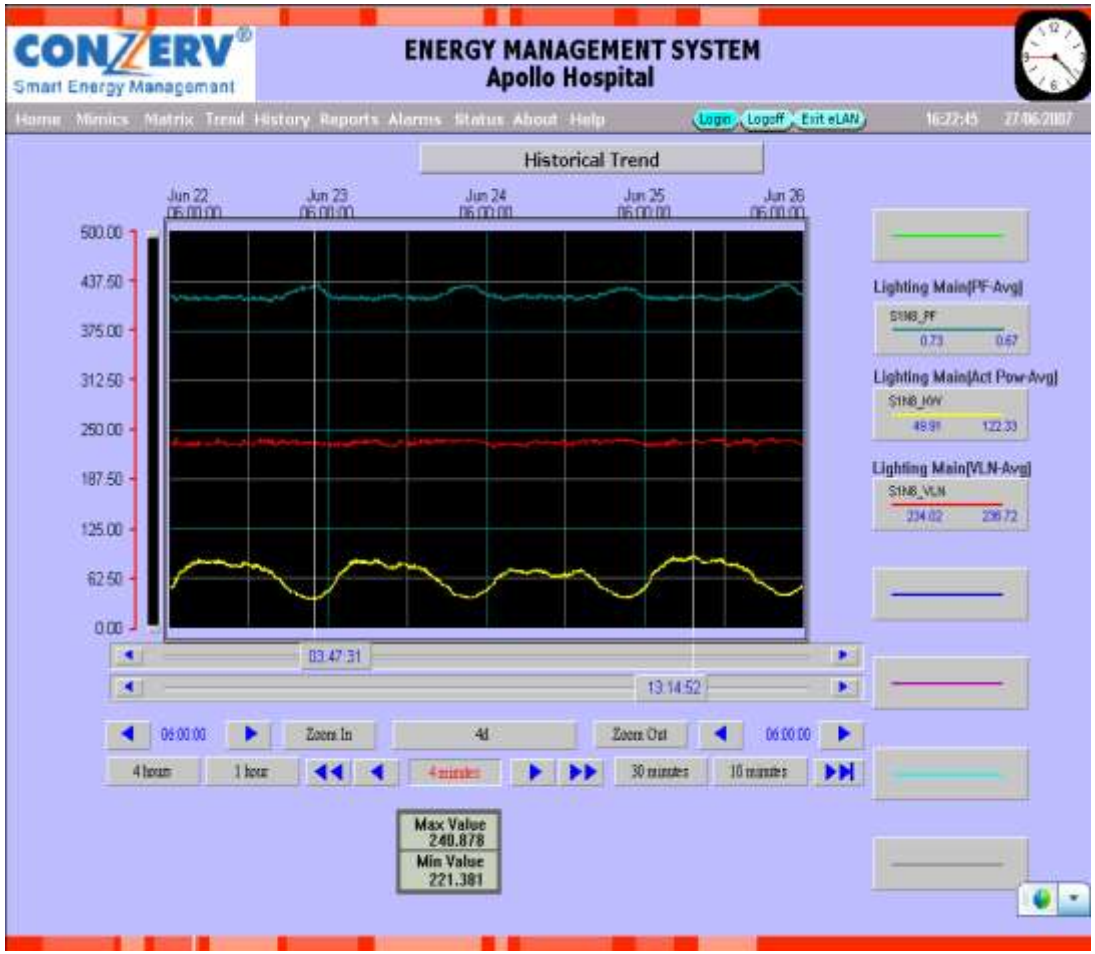
Observations



	7-Jun	8-Jun	9-Jun	10-Jun	11-Jun	12-Jun	13-Jun	14-Jun
350 TR	1624	1144	1611	1615	1164	1141	1564	1420
190 TR	106	757	265	61	1018	1036	378	501
AHUs	513	571	619	628	606	614	567	571

It is observed that AHU load is constant even though the chiller load varies

Lightings



Time	V_{LN}	kW	PF
Day	230	125	0.67
Night	240	53	.73

- Voltage can be optimized
- No Lighting stabilizer found
- Lighting power reduce by 15% (80 kW*15%=12 kW) by installing lighting energy savers
- Improve PF by capacitors

Observations….

- Medical Equipments
  - High harmonic Distortions

  This Leads to equipments failure, Capacitors banks malfunctioning, Overheating of cables
- Unbalanced load
  - In Transformer 1 - 100 amps (20%)
  - In Power line feeders – 70 amps (30%)
  - A/C plant 2 – 100 amps (33%)

Recommendations

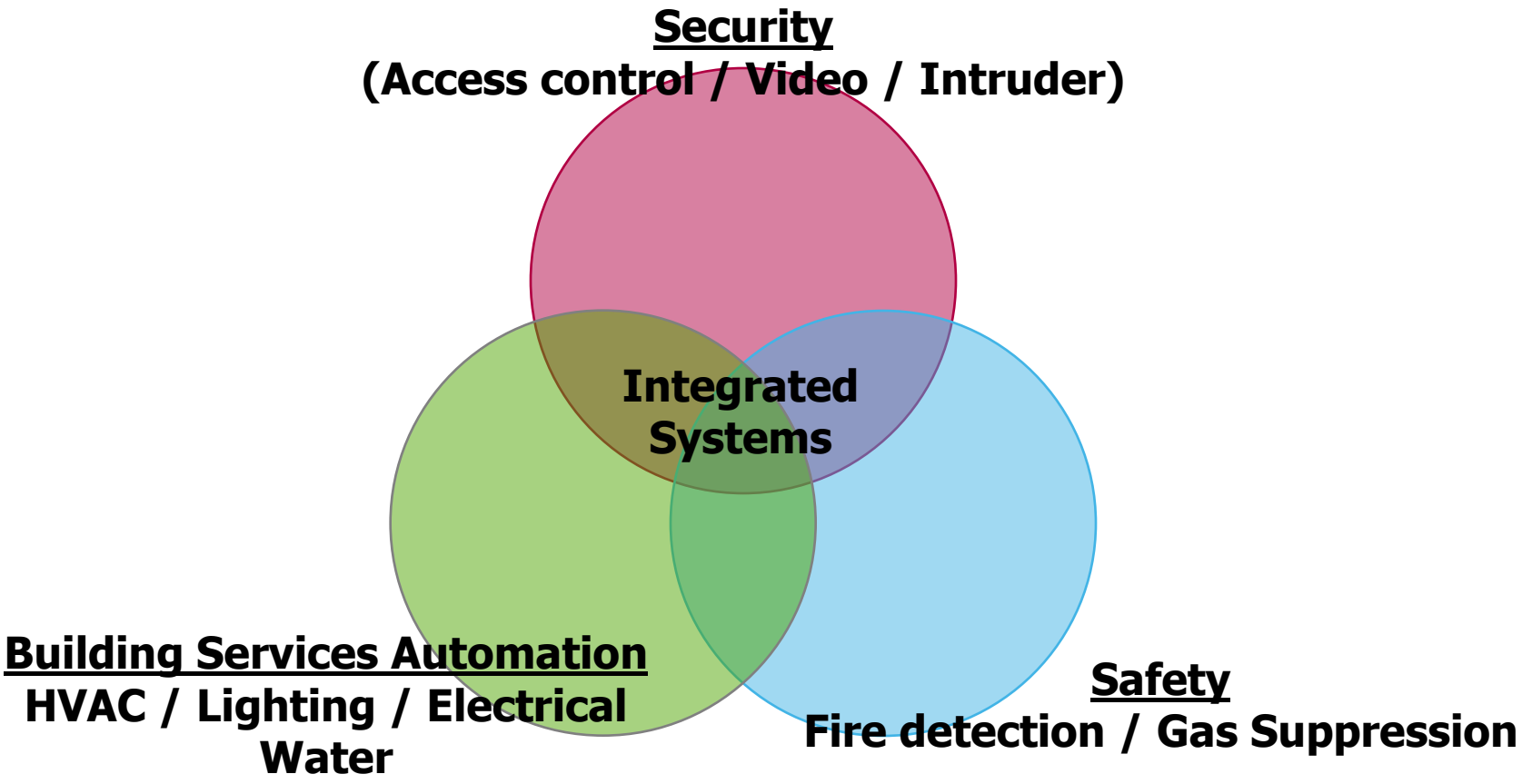
- **Permanent installations of EMS can helps to monitor all the observations mentioned and improve accordingly.**
- **Replace the existing APFC relays with new relays in each of the transformer to control PF fluctuations**
- **Install new APFC panel or only relay in the A/C plant feeder to avoid leading power factor**
- **Conduct detailed energy audit to improve energy efficiency**
- **Install Demand controller to switch OFF the non critical loads during demand exceeding to enable reduction in demand by 10%**
- **Monitor CT Sump water temperature to evaluate the possibility of reducing CT fan power**

Recommendations…

- Operate the pumps based on the Chiller load
- Install voltage stabilizer to reduce light power consumptions
- Possibility of shifting loads from Tr1 to Tr2 . This will improve PF and loading of Tr2.
- Check the power consumption when A/C plant switches OFF (presently 1 kW to 5.5 kW)
- Take steps to reduce the existing harmonic level or conduct detailed harmonic study

Building Management Systems

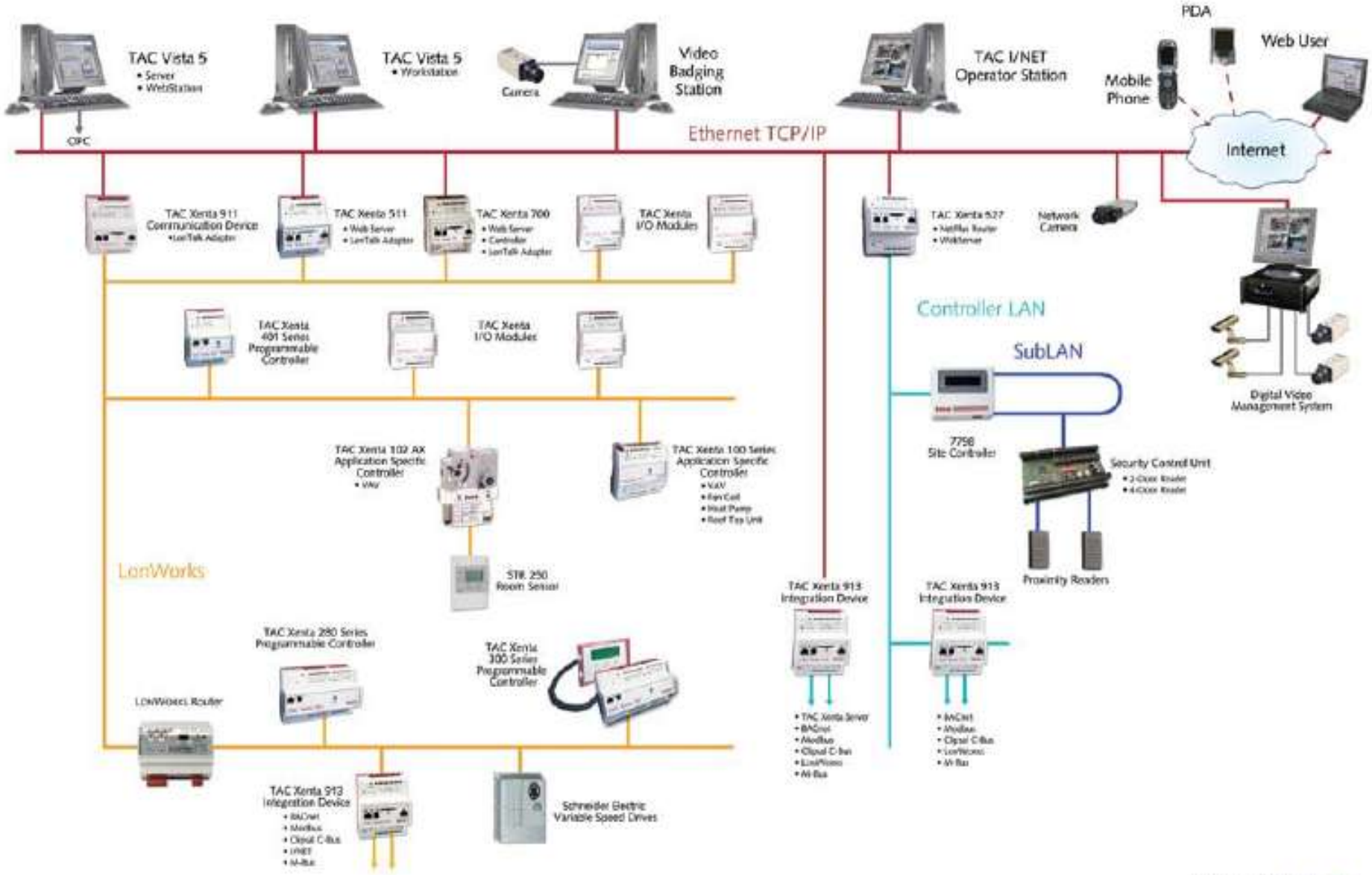
Our Domain


Security
(Access control / Video / Intruder)
Integrated Systems
Building Services Automation
HVAC / Lighting / Electrical
Water
Safety
Fire detection / Gas Suppression

Advantages of an Integrated System

- Reduced Opex. and Capex.
- Coordinated Services
- Better Disaster Management
- Improved MIS for the Facility Manager
- Energy Monitoring and Mapping the Energy profile of the Facility
- Integration with Third Party Systems viz. Chillers , DG PLC , PACs, Energy Meters via Open Protocols.
- Personalised Environment Management and Energy Saving Strategies.

Integrated TAC Vista™ Architecture



TAC Vista

BMS

- TAC Vista front end
- Open Protocol- LONWORKS.
- 32 bit DDC Controllers with RTC on board.
- Range of freely programmable and Application Specific Controllers.
- Controllers capable of working in Standalone mode. Peer to Peer communication.
- Range of Valves , Sensors and field devices from TAC.
- Integration with Third Party equipments viz. Chillers , DG , PACs , UPS etc
- OPC / Web Monitoring.
- Simple to use and Powerful graphics – Reduced Training time and Costs

Access Control

- Seamless Integration with TAC Vista.
- Networkable/ IP/ POE Controllers.
- 2 Door/ 4 Door/ 8 Door Configuration.
- Standalone with RTC on board.
- Wiegand/Proximity/Smart Card/ Biometrics.
- High Level Encryption for data transfer.
- Web Monitoring.
- Modular and Expandable.
- Multi-Tenant.
- Elevator Control /Lighting Controls.
- Visitor Management
- Intruder Alarm.
- DVMS Integration.

Video Surveillance

- Pelco and Integral.
- Pelco widely recognised in Refineries, Oil and Power sector a
  Process Industries.
- Integration with TAC Vista / TAC I/NET
- Range of Analogue and Digital High Resolution cameras.
- Range of Analogue DVRs / Hybrid DVRs.
- System expandable from a few cameras to unlimited camera
- Unlimited Network recording for IP Solutions.
- Video Analytics.

FX- analytical addressable fire detection panel

- flexible modular construction
- big 320 x 240 pixel LCD display
- all configurations done with Fx- configuration SW
- all inputs / outputs are configurable
- access level codes set with conf.-SW
- Several helpful functions for commissioning.
- SW- update with PC.
- all languages and features on the same SW
- powerful power supply & loops

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Make the most of
your energy

Thank You