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Enhanced Energy Efficiency in Indian Green Data Centres

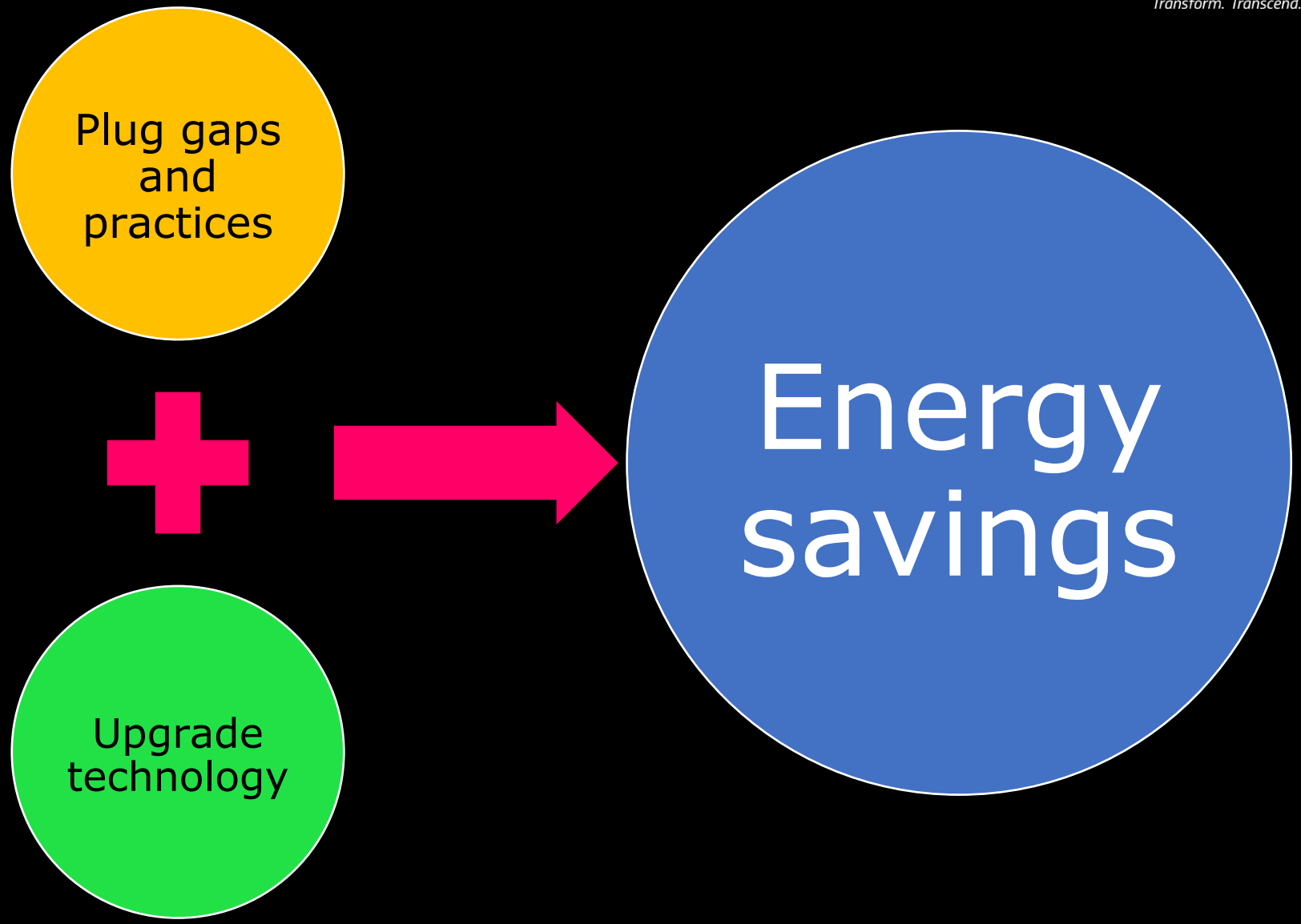
Upgradation of Technologies and Key Operational Benefits from a facilities perspective

Lets not lose focus on what a green data center is:

A **green data center** is a repository for the storage, management, and dissemination of **data** in which the mechanical, lighting, electrical and computer systems

- are designed for maximum energy efficiency
- and minimum environmental impact.

https://searchdatacenter.techtarget.com/definition/green-data-center


Plug gaps and practices
Upgrade technology
Energy savings

Upgradation of Technologies

Upgradation starts at your office:

> Go off-Premises!

- Move your equipment out of your premises to a specialised data center.
- Netmagic Data Centres offer facilities offer technologies and solutions to ensure energy is used more efficiently. These may include:
  - Power delivery systems that minimize loss
  - Sophisticated cooling solutions
  - Relation ships with utilities, express feeders, scalable power and connectivity, generators for backup
  - Buildings designed to conserver energy, optimise cooling
  - Redundant networks, lower bandwidth costs, blended bandwidth
  - Specialised HR teams

Trends, 2018…

- Automation technologies that communicate status, performance and capacity information : GAINING CONTOL OVER DC DATA
- Smarter data centres where critical infrastructure OPERATES AUTONOMOUSLY till the edge
- Software-defined POWER AND COOLING INFRASTRUCTURE – driving better resource utilization and better asset management
- Networks
- Modular, to meet consumption-based

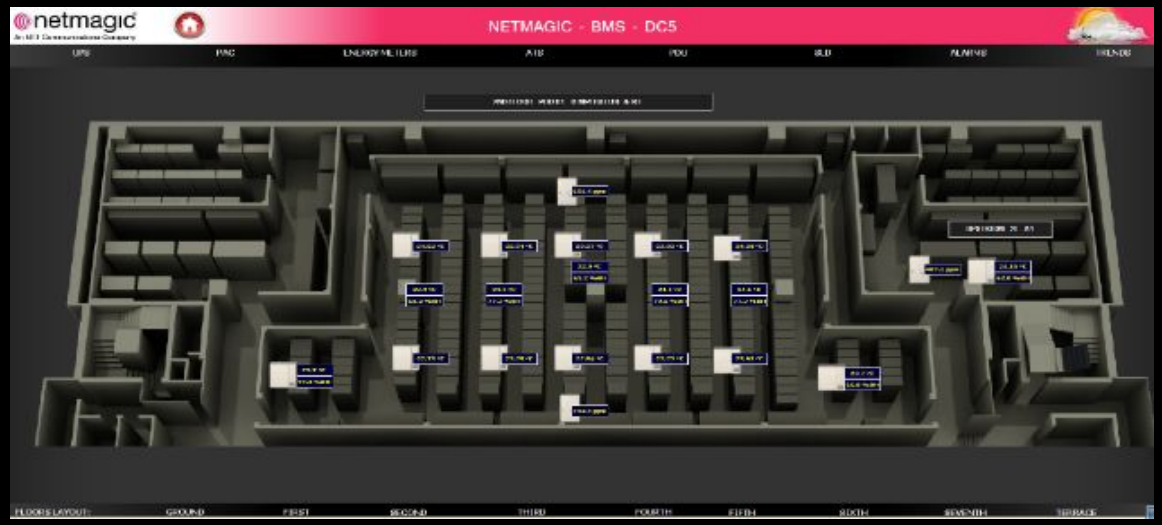
- *IDC Futurescape Worldwide DC Predictions 2018 APEJ https://www.idc.com/getdoc.jsp?containerId=AP42219717*

Netmagic's Resilient BMS systems with capability for data analytics

- REDUNDANT Programmable Logic Controller (PLCs)
  - - with Redundant Power supply ('UPS A'+'UPS B')
  - - Redundant LAN Network (Network A + Network B)
  - - Redundant Servers for IBMS Applications, with physical machines and on Netmagic Cloud infrastructure.
- ETHERNET IP technology to interface with Various utilities and devices, rather than daisy-chain serial or Master-slave type of interfaces / hierarchies.
- The use of SNMP/IP instead of Modbus RTU Serial or BACnet MSTP protocols to reduce latency and lag issues.

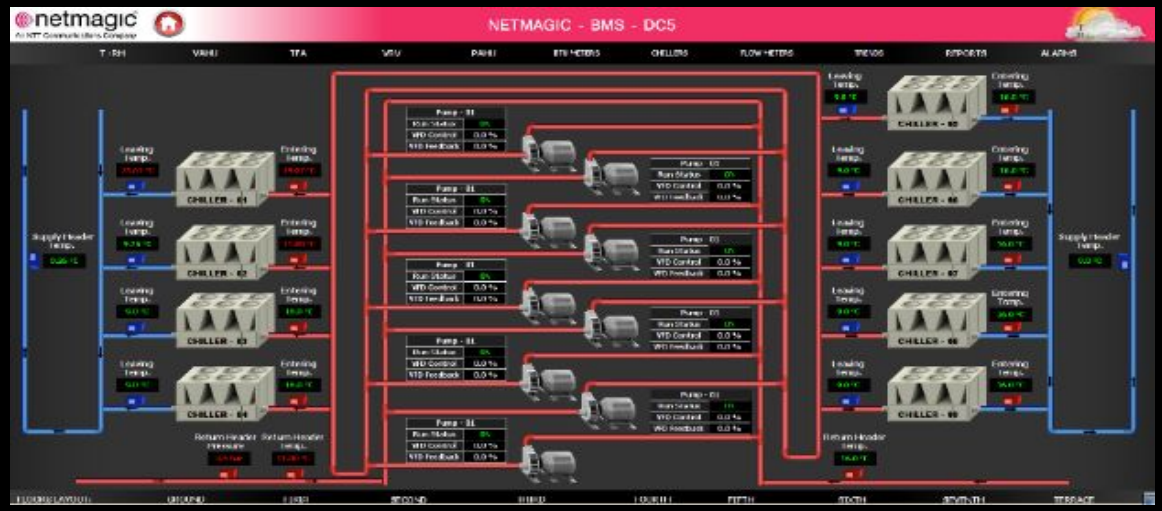
Data Analytics Application with GUI, Requirements

- Extensive GRAPHICS Functionality for HVAC / Electrical / Fuel Management / Auxiliary Systems, with online display of parameter values,
- DATA ANALYTICS and Dashboard display draws data from the IBMS Database, and presents actionable information to the O&M team.
- System provides ONLINE DASHBOARDS for Real-time data, and also for graphical information. Compares measured parameter values against historical data and/or against set-points for Energy Performance, PUE, Electricity per sq.ft, Diesel per sq.ft / Shift, Proportion analysis as per FM Requirement, Budget vs. Actual



Temperature and RH

Sample Floor



Chillers

Fire Alarm System

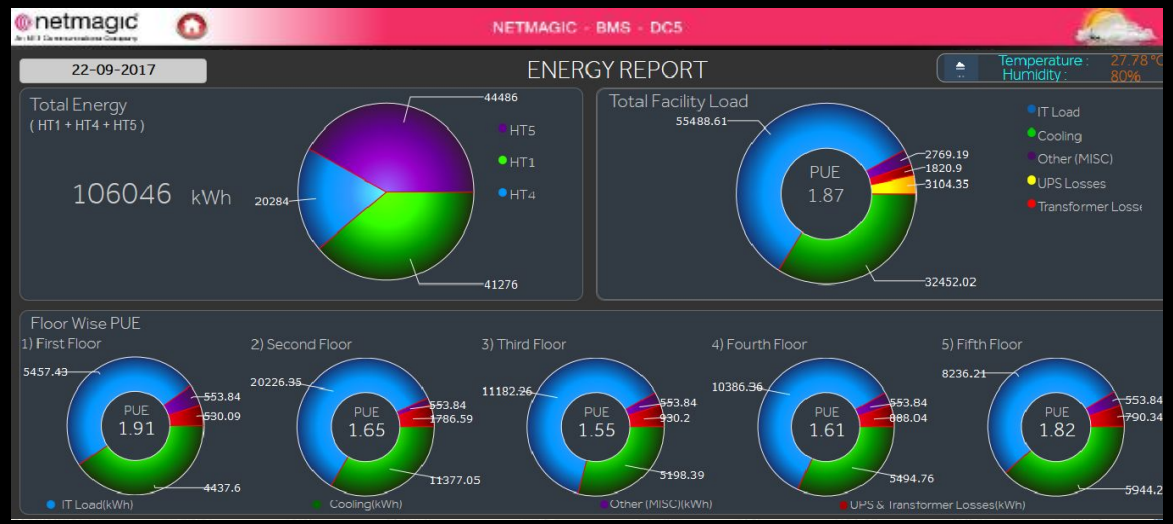
IBMS & Data Analytics Application with GUI, Requirements

- Energy / Utility CONSUMPTION SOFTWARE MODULE provides VIEW of monthly consumption, detect deviations, compare and benchmark with design values or past consumption
- Energy software TRACKS direct consumption of Electricity / Fuel / Water, giving powerful tool for identifying potential savings.

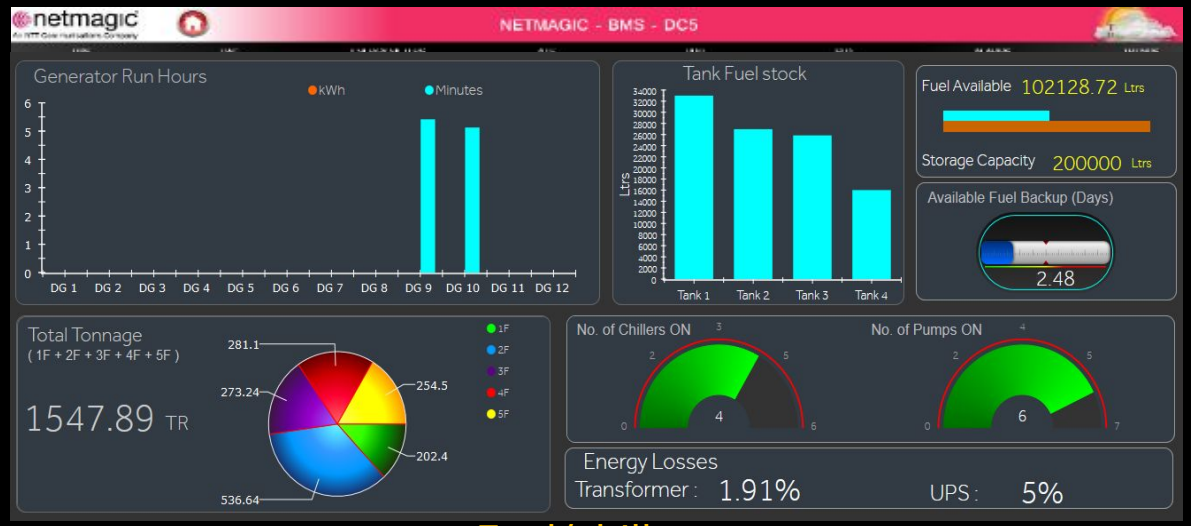
Utility Metering and on line display

- For MEASURING, CHARTING AND TRENDING of usage of Electricity, Water and Air-conditioning,
  - Data from ENERGY METERS provided in the Electrical Design to monitor the usage of the Electrical Energy at various stages.
  - Data from BTU METERS provisioned in the HVAC Design to ensure a Real-time measurement of the BTU being consumed, soft integration with the Chiller plant Manager.
- Such data generated is TRENDED on a time chart, and consumption patterns studied and analysed to bring in energy efficiency measures.

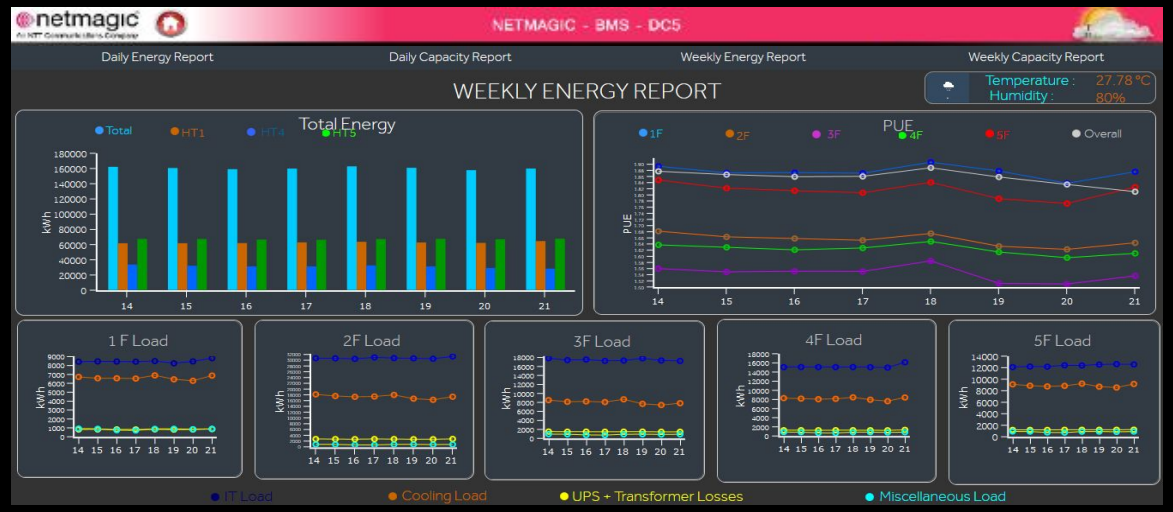
Technology Upgrade: BMS



Energy Report in Real-time



Fuel/chiller



Weekly energy report

Electrical Power Management report

Trending

- provides a FLEXIBLE TRENDING TOOL that allows real-time, historical or achieved data to be trended in a variety of formats.
- COMPARISONS between data e.g. current real-time data versus archived data with following functions.

  Real time trending | Historical trending | Archived history trending

  Trend scrolling | Trend zoom | Engineering unit or percent | Copying of currently displayed trend data to the clipboard for pasting into spreadsheet or document.

Reporting and Alarm Management

- A WELL-ORGANIZED ALARM MANAGEMENT FUNCTIONALITY enables the Netmagic engineers to react quickly and efficiently to alarm conditions.
- 6 LEVELS OF ALARM COLOUR CODED PRIORITIES All alarm logged in the event / alarm file and / or on the alarm printer.
- On ACKNOWLEDGEMENT it is possible to automatically issue a reset command to the controller so as to reset the alarm point.

Reporting and Alarm Management

- time and date stamp of occurrence and are automatically disabled for those input points or systems that are not currently active or not are part of an active delivery path to PREVENT NUISANCE ALARMS.
- Supports a flexible REPORTING PACKAGE to allow easy generation of report data. Standard reports that are configurable to meet specific customer requirement.
- The IBMS system has extensive ALARMS MANAGEMENT MODULE, and it is possible to relay alarm NOTIFICATIONS TO THE FACILITY TEAM VIA SMS AND EMAILS.

IBMS Network Deployment

- INDEPENDENT, REDUNDANT LAN NETWORK using Copper backbone at the Field level, and Fiber backbone between Managed Switches for Network Communications
- BMS Equipment Room 'A' AND 'B' PER FLOOR, each housing L2 Switches and Modular Patch Panels .
- Redundant and cross-connects between rooms and PLC
- STAR topology.
- UPS POWER Supply 'A' and 'B' at all BMS Equipment Rooms, PLC Locations, IO Module Locations, BMS Equipment Rooms and auxiliary locations

POWER AND COOLING UPGRADE

Upcoming DC3B / DC6M:

Technology Upgradation: Data Center-specific energy-efficient chillers.

Newer chillers in DC3B

- DATA-CENTER-SPECIFIC CHILLERS – first time in India , imported from Italy
- Energy efficient ADIABATIC chillers – increases seasonal efficiency by reducing local ambient temperature
- Larger FOOTPRINT compared to normal chillers

Newer chillers in DC3B

- SECONDARY PUMPING with sensor-less speed control, < pumping cost, > energy efficiency
- A move from Variable primary in DC5 to variable secondary in DC6
- BUILT-IN CHILLER PLANT MANAGER (CPM) in each chiller, communicates with all other chillers in the group, eliminates third party CPM.
- The BUILT-IN PRIMARY PUMP in each chiller which can work either on fixed speed or on variable speed depending on the control logic of the chiller manufacturer.

Introduction of upgraded chiller technology

- More efficient operation at HIGHER OPERATING TEMPERATURES (at 20*C to 27*C instead of 7*C to 12*C) resulting in lower KW/TR.
- Mumbai DC5: 9-16’C Mumbai DC6: 15-21’C Bangalore DC3: 20-27’C
- Bangalore DC3 inlet air temperature 24.5’C because the chiller outlet is 20
- At Bangalore DC3, FREE COOLING OPTION- ambient related –w/o compressor
- BUILT-IN DUAL COIL ARRANGEMENT to make use of free cooling in case the ambient is lesser than the return water temperature. (Winter and night time operation- especially in the Bangalore region where the winters are cooler than Mumbai).

Introduction of upgraded chiller technology

- VERY LOW QUICK-START period ranging from 90 seconds to 120 seconds as against 300 seconds in DC5
- Provision for CONNECTION TO PAHUS on the floor when the DC is populated.
  – set point based on the load

Thermal Storage using a cylindrical tank in the de-coupler line

*4*25,000 litres. Units A and B.*
*In our upcoming DCs, we are using a thermal storage system in the form of cylindrical tanks inserted in the de-coupler line as against the 600mm and 900mm feet diameter pipe type used in series in DC5M/DC2B. LEFT and CENTER ="A" side tanks, RIGHT="B" side tanks, 4*25,000 litres each*

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Better cold aisle deployment at the upcoming DC3B: better floor tiles delivering higher air-flow

Pressure sensors *too have been introduced.*

LEFT: cold aisle containment

RIGHT: the un-contained hot aisle showing load banks for ISAT .

CENTER: pressure difference sensors.

Total Quantity of UPS Required per floor DC3 = 4*1000 KVA* 6 floor

Total Quantity of UPS Required per floor DC6 = 8*1000 KVA* 6 floors

***Modular** UPS : for DC6M and DC3B we have gone in for **highly efficient** 1000KVA modular systems which raises efficiency from 94%to 96% and can be started with the starting power for the floor, and be ramped up as load increases.*

People training

- on-site training from our UPS and chiller OEMs for all technicians
- On-boarding of SMEs Power, Cooling, Mechanical, Civil
- IT team – facility team linkup for checking of customer IT equipment during on-boarding
- Quarterly Upgradation e.g. CDCP etc., part of the quarterly KPI

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Ongoing initiative

to maintain thermal stability, a corridor has been created around the server hall. 1) the corridor prevents thermal instability (2) Non-entry of PAHU technicians into the server hall has an effect on cooling that can be avoided. *The server hall is the area entered via the blue door on the RHS.*

Upgrade IT Equipment like servers/installation practices

- move to dual source (A+B source) equipment
- Check upgrades of customer IT equipment: more computing power, reduced energy use and lower heating.
- same amount of computing work can be done with far fewer servers, less capital, less heat
- Advise cabling practices

Higher server room /passage temperatures

- ASHRAE has in fact now recommended an acceptable operating temperature range of 64° to 81°F (18° to 27°C).
- Bangalore DC3 looks at 24.5'C
- Energy Efficiency Improvement Plan and Execution was used to track the PUE improvement on a month-to-month basis.
- Our facility team is convinced that we can reduce the PAHU consumption further by increasing the temperature set point. The common passage cooling unit set point can increased further and can be optimised the energy consumption. However, both the above have drawn disagreement from customers' IT managers who want traditional settings.

- **Data Center Monitoring**

Advances in civil technology: concrete facade

glass façade versus a concrete façade – better thermal efficiency translating into energy savings.

Bare concrete: minimum environmental impact.

IGBC Green Data Center

The rating system addresses the following aspects:

- Energy Efficiency
- Operation & Maintenance
- Water Conservation
- Indoor Environmental Quality
- Site Selection and Planning
- Building Material and Resources

Implemented rigid and flexible cold aisle containment to avoid AC leakages and efficient usage.

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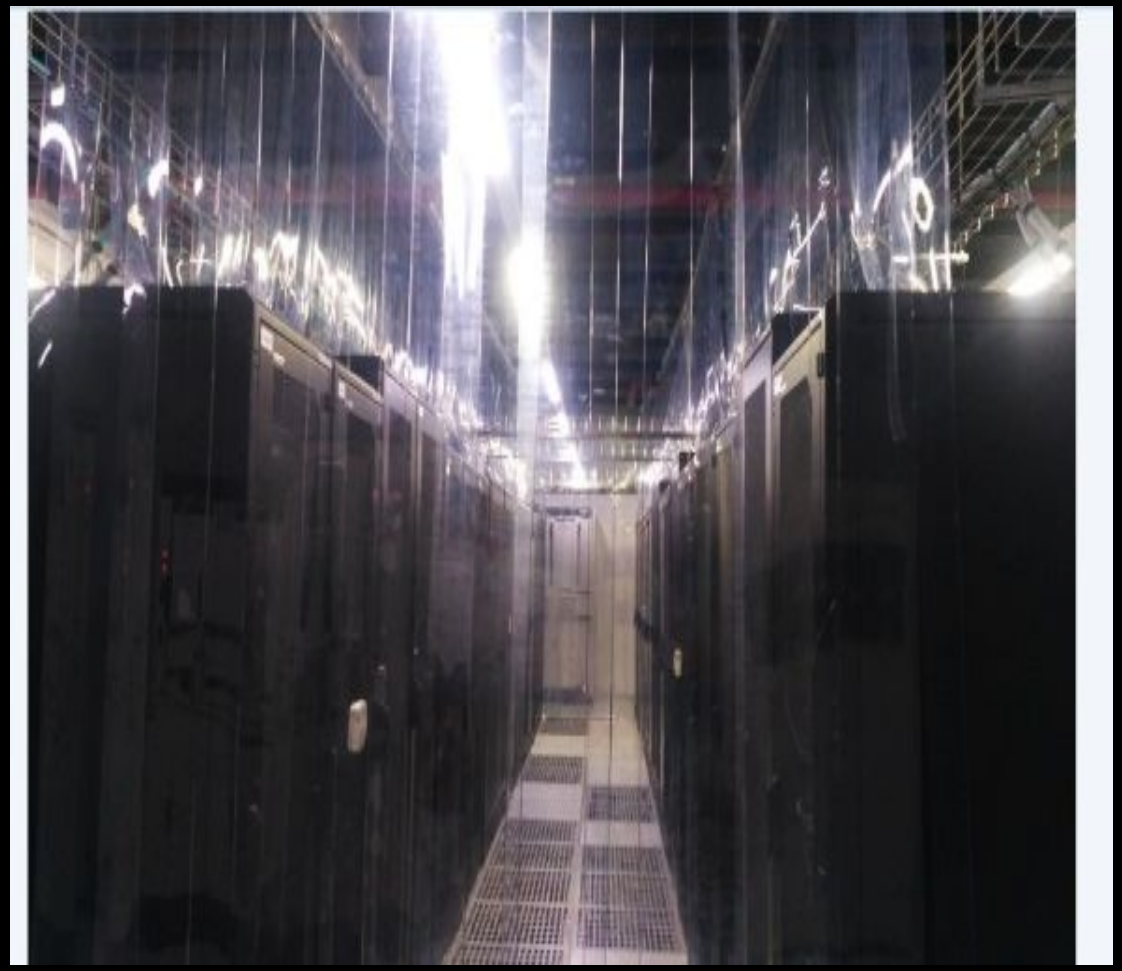
Flexible Containment



Solid Containment

- Increased PAHU’s Set point from 18°C to 21°C delivery temperature in SH03 PAHU Machines and achieved savings.
- Increased PAHU’s Set point from 22°C to 24°C return air in SH02 PAHU Machines and achieved savings.
- Nitrile Insulation: something as simple as nitrile rubber has been topped with a sheet of foil to reflect/reduce heat loss.
- All cold water pipes have been factory-insulated

Blanking Panel Empty Rack Area

Blanking panels for Rack U Space

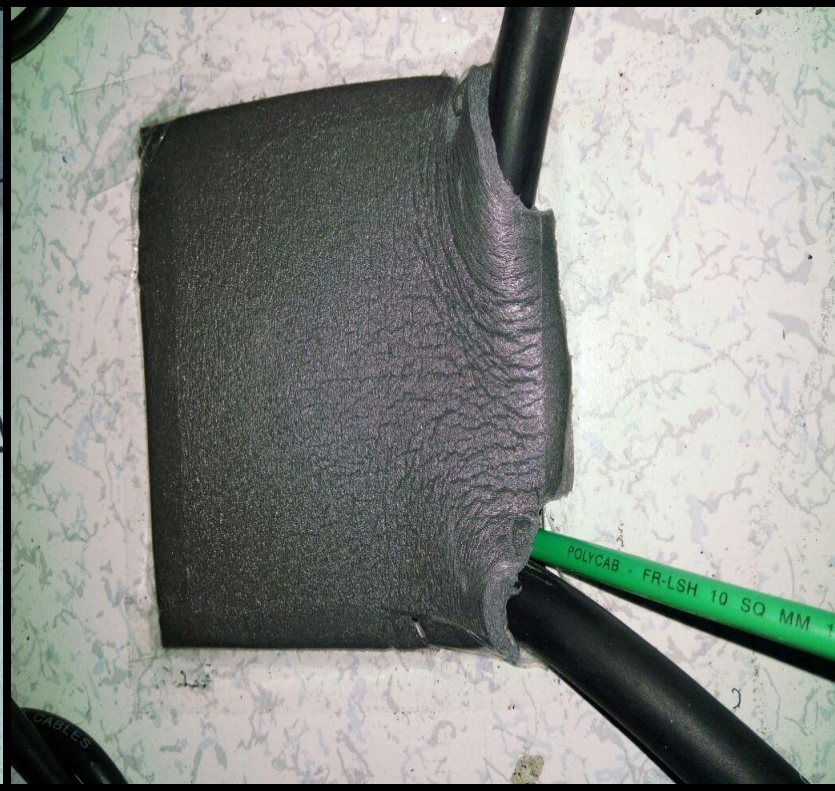
- ✓ Under-raised-floor blocking done till rack utilization to avoid air loss.
- ✓ Closed PDU side gaps to avoid air loss.
- ✓ Closed cable manager at rack levels to avoid air loss.

Actual photographs at site:

Unused Area Under raised floor Blocking

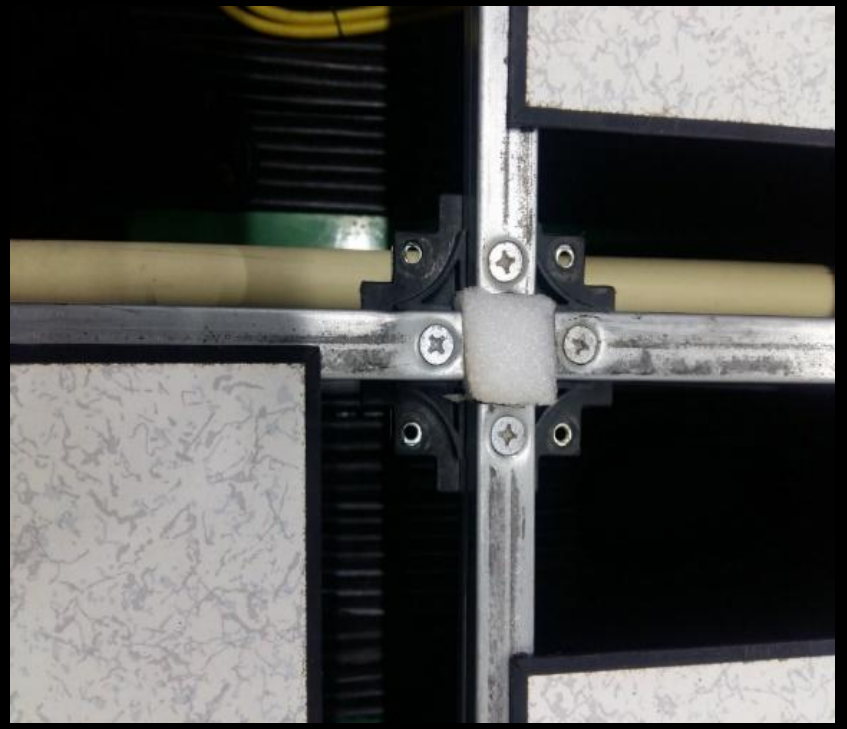
PDU side gap Blocking

Cable Entry cut outs Blocking



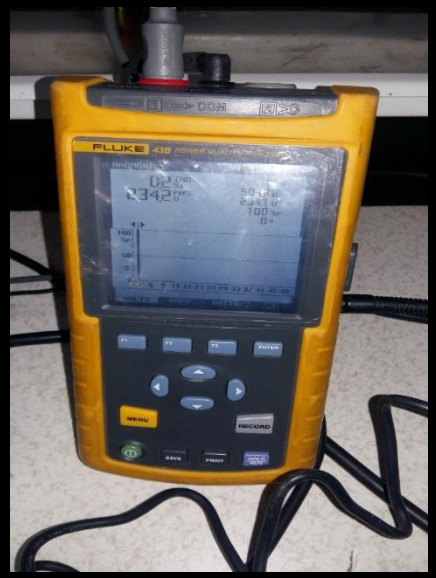
Raised floor tile gaskets

Arresting Air Leakages in Raised floor



Arresting Air Leakages Around PDU's & PAHU's Inside SH

Periodic Calibrations of sensors



List of projects undertaken to achieve energy savings.

- ✓ Chiller Plant Manager implemented for accurate chiller operation, load balancing and auto fail over to standby units to avoid temperature raising.
- ✓ PLC (Pump Logic Controls) implemented for variable primary pumping system of chilled water pumps with coordination of differential pressure sensors on floor levels/Halls.
- ✓ In-row cooling machines implemented for efficient heat transformations for high density racks (80 racks averaging 22KW each).
- ✓ Deployment of green power UPS systems to achieve KVA=KW ratio on full utilisations.

- ✓ Increased PAHU's Set point from 18°C to 21°C delivery temperature in SH03 PAHU Machines and achieved savings.
- ✓ Increased PAHU's Set point from 22°C to 24°C return air in SH02 PAHU Machines and achieved savings.
- ✓ AFPS (Auto Floor Pressure System) enabling for PAHU Machines with variable fan speeds.

- Deployment of **cowling** on our roof-top chillers prevented hot air recycling leading to increased chiller efficiency and lower alarms.
- **Adiabatic cooling** for the chillers improved efficiency.
- Moving the pumps from VFD pumps to **PLC controllers** improved efficiency.
- **Electronically commutated** fans in the server room PAHU units improved efficiency.

- Replacement of traditional lights to T5 / **LED lig**hts has reduced power consumption.
- As a bonus point, this exercise also **identified any single point of failure** in the system and helped us to build up a resiliency in the system.
- A second bonus point was the identification of discarded plastic bags and paper note sheets **inside customer racks**, which was a potential fire hazard.

Thank you!

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