CFD Based Alarming and Decision Support System Optimizing Load Allocation in Data Centers

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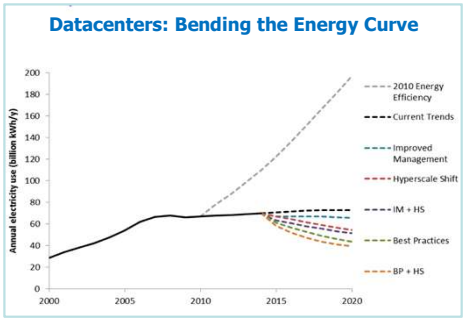
7X24 Exchange The end-to-end reliability forum.

Motivation:

Demand for datacenter capacity in the US grew significantly over the past decade while their total energy consumption grew in a much slower pace.

- US datacenters electricity consumption in 2014 ~70 billion kWh (~ 2% of US total consumption)
- Represents 4% increase in since 2010
- 2005 to 2010 increase was ~24%



Projected Data Center Total Electricity Use

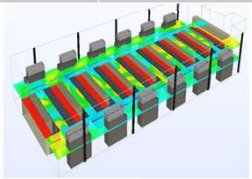
(Source: US Department of Energy, Lawrence Berkeley National Laboratory)

Cooling systems energy consumption in data center can be over 40 % of total energy consumption.

One can operate more efficiently by operating the datacenter at higher temperatures, reducing the cooling demand of the data center, but this has limitations.

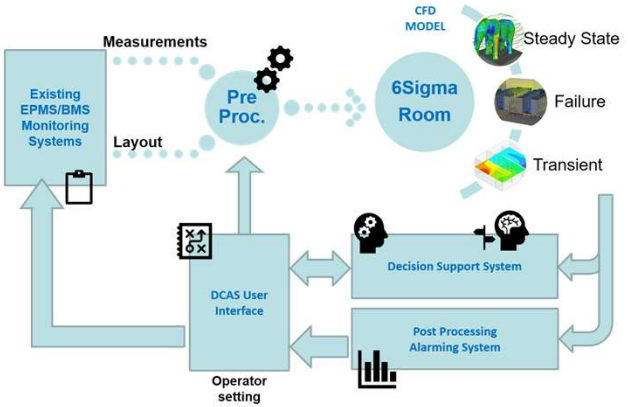
ASHRAE established that the environmental conditions for this equipment should be in the following ranges:

State	T in Celsius	T in Fahrenheit
Steady State (High)	27°	80.6°
Steady State (Low)	18°	64.4°
Transient State allowable	32°	89.6°



There is a fundamental trade off between improving efficiency and decreasing risk

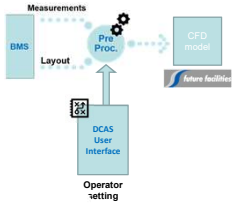
Dynamic Computational Fluid Dynamics (CFD) Analysis:



Preprocessing Stage:

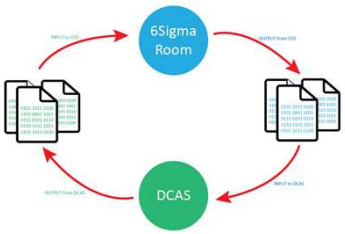
- [Periodic] Processing datacenter layout:
  Rack row/columns location; Rack indexing; Rack 0-42U power reading;

- [Daily] Data collection:
  Reading updated racks (U resolution) power measurements from the building management system (BMS) over 24 hours &
  Setting maximum point for each rack



- [once] Operator settings:
  Transient duration &
  Temperature threshold setting for allowable and recommended

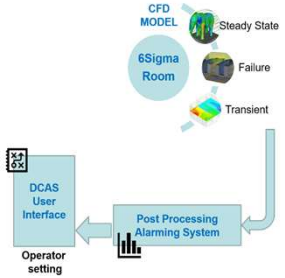
Automation:



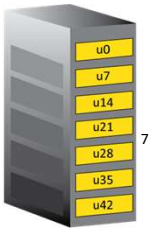
[Daily] Automatic generation of 6SigmaRoom CFD simulator input

Post-processing Stage:

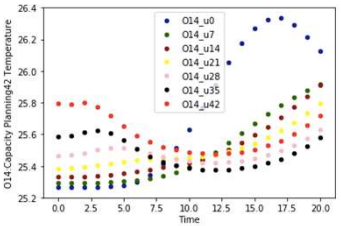
- 6SigmaRoom generated data analysis:
  - Steady state: per rack per u temp
  - Transient: 0-20 seconds
  - Failure (CRAC unit)
- Use 6SigmaRoom to generate alarms:
  Reading updated racks (U resolution) power



Rack O14:



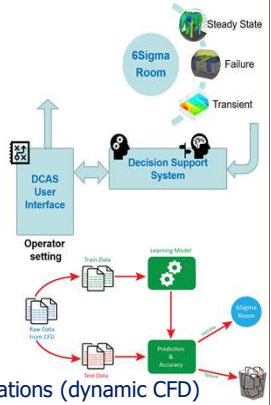
7 u's



Decision Support Stage:

Installation of new server

- Operator defines: Rated Power & Location (rack/u)
- System build an updated 6SigmaRoom input file and runs simulation
- Based on steady state/transient /failure analysis return 'advise' to operator for decision making



Benefits of Implementation

Energy savings:
Safe operation closer to design limitations (dynamic CFD)
Preventing heat pockets by decision support system

Risk mitigation:
Real updated CFD model that constantly evaluates based on real world conditions
Based on dynamic CFD opened new opportunities to maximize utilization while minimizing risk

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