Data Centre Cooling: Efficient and Reliable with AC Drives

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Agenda

- Energy savings with AC Drives in Data Centers
  - Applications: Fans, Pumps and Compressors
- Energy efficient heat management in AC Drives
- AC Drives as smart sensors – Condition Based Monitoring
- Data Centre Case Studies
- Conclusions

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Energy Savings with AC Drives in Data Centres

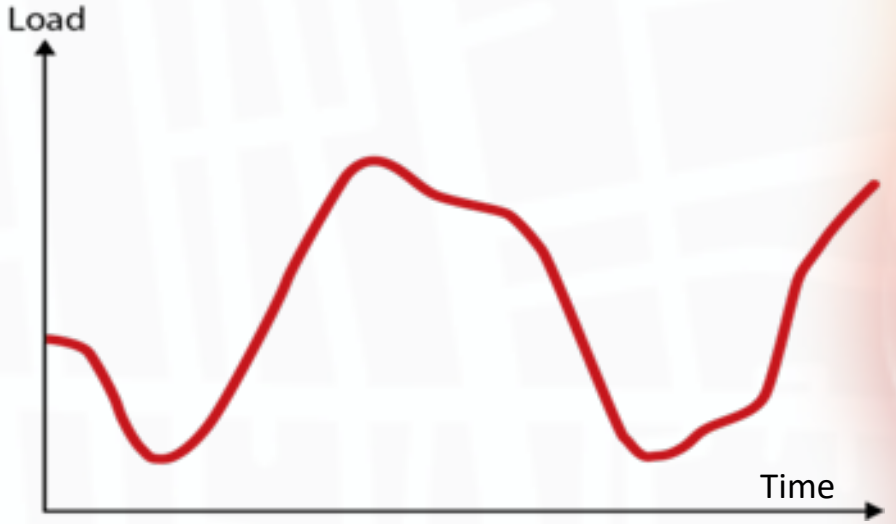
Cooling, Fans, Pumps and Compressors

Why use AC Drives in Data Centres

- The considerable daily cooling load variation in Data Centers makes it economical and attractive to install AC Drives on more or less all rotating equipment such as fans, pumps and compressors.

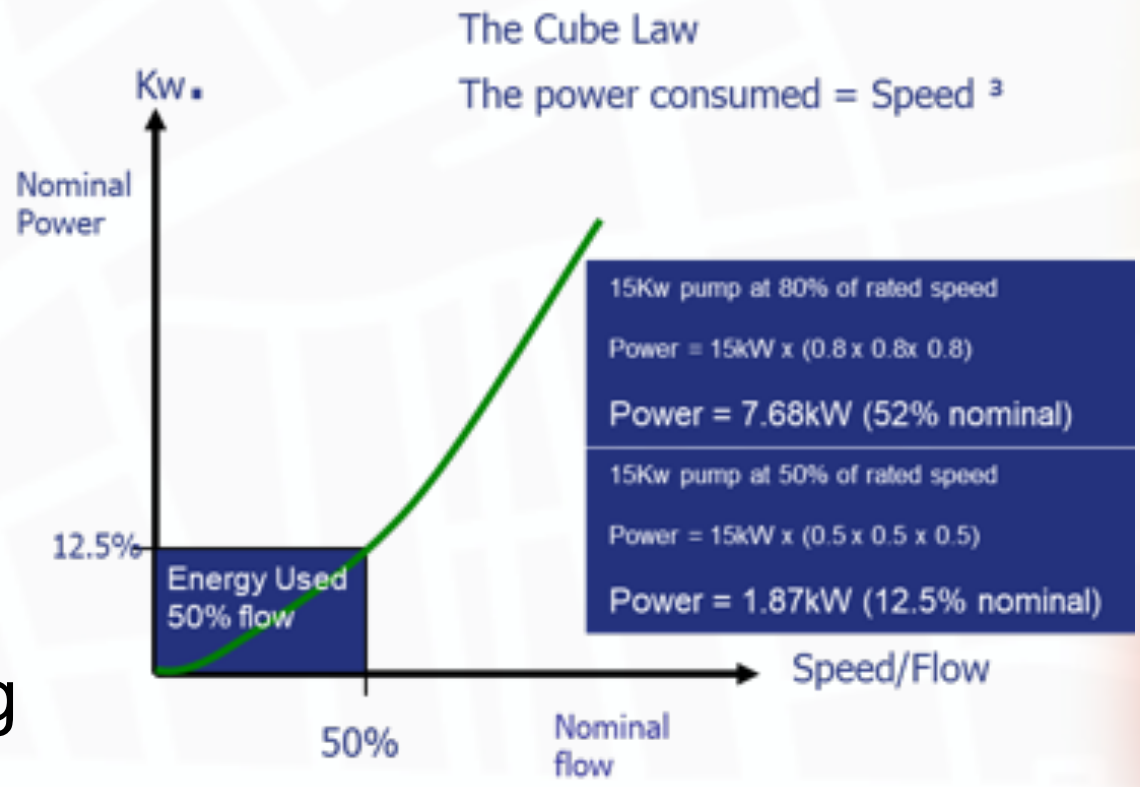
The benefits obtained are typically:

- Substantial Energy Savings
- Better asset protection
- Less maintenance cost
- Higher plant reliability/performance

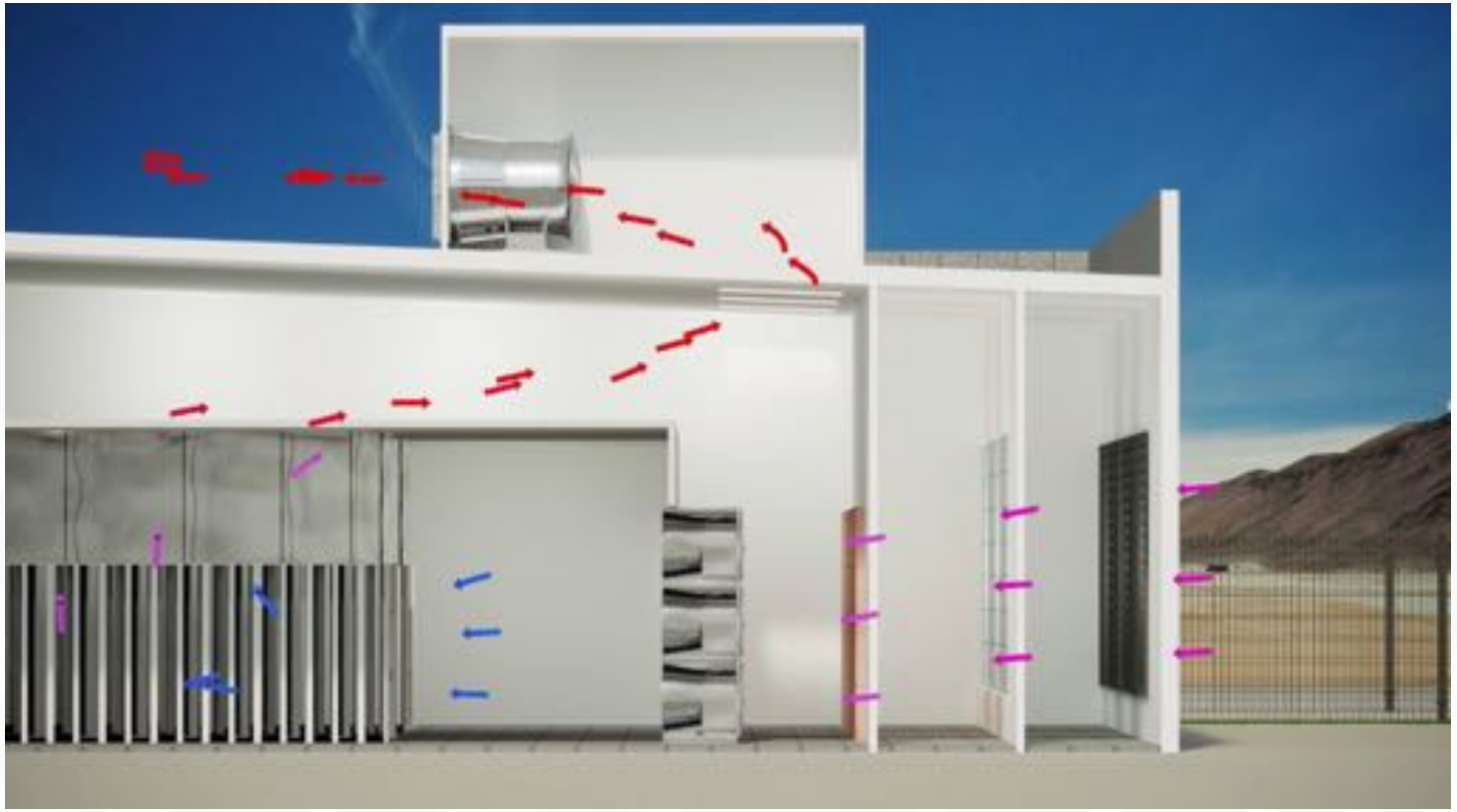


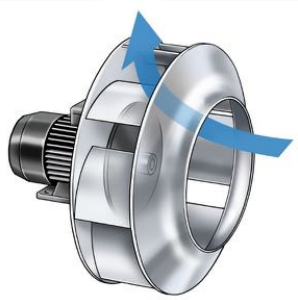
Control your Fan, Pump or Compressor

- Obtain 10-90% energy savings
- Just 20% reduction in Pump / Fan speed brings ~ 45% energy savings
- AC Drives on Screw Compressors typically bring 10-25% energy savings



Choosing most energy efficient solutions – e.g. High Efficient Fan Solutions





Plug Fan – Typical system efficiency ≈ 60-65%

High Efficiency Axial Fan – Typical system efficiency ≈ 80-85%

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New High Efficiency Solution

- New High Efficient Fan Solution sets new standards
- Total System Efficiency up to 85% exceeding current EC Fan and Plug Fan System Efficiencies with up to 20%

92%

High Efficiency Axial Fan for AHU and Data Center Ventilation

X

95%

High Efficiency PM Motor

X

97%

High Efficiency AC Drive With motor technology independency

=

85%

Highest Efficiency Solution

Intelligent Heat Management in Data Centres

Intelligent heat management

Back-Channel Cooling

- 90% of the heat can be kept outside the control room, requiring less energy to control the control room temperature

Intelligent heat management

The back channel cooling concept transfers up to 90% of heat away from the room. Typically 0,4 W of energy needed to remove 1 W of heat.

The energy saving for a 160 kW drive will equal approx. 15 % of initial investment made in a standard AC drive

160 kW High Efficient AC drive: Heatloss 2,4% ≈ 3.770 W.
AC saving ~ 3,77 kW * 0,9 * 0,4 AC * 0,1 US$ * 0,6 load * 24 h * 365 d = 713 US¤/year
~ 15 % of AC drive purchase price per year of operation over the lifetime of the AC Drive

AC Drives as Smart Sensors – Condition Based Monitoring

Modern AC Drives as Sensors

- Traditionally, drives have been considered power processors for controlling the motor speed.
- Modern AC Drives open new opportunities by becoming part of the information chain, using the advantage of built-in processing power, storage capacity, and communication interface, within the drive.

Condition-Based Monitoring

Condition Based-Monitoring provides many advantages such as:

- Downtime reduction
- Elimination of unexpected production stops
- Maintenance optimization
- Reduction in spare part stock inventory

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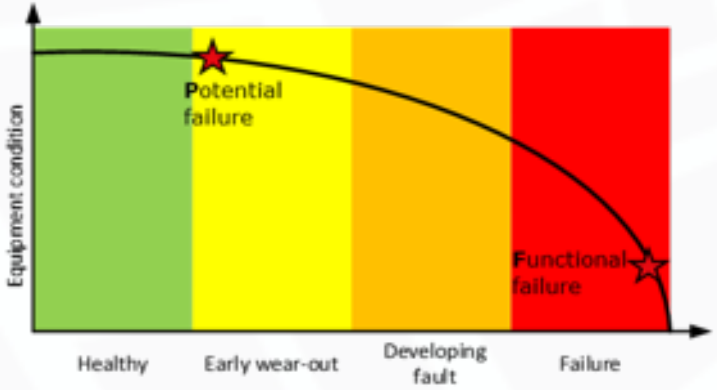
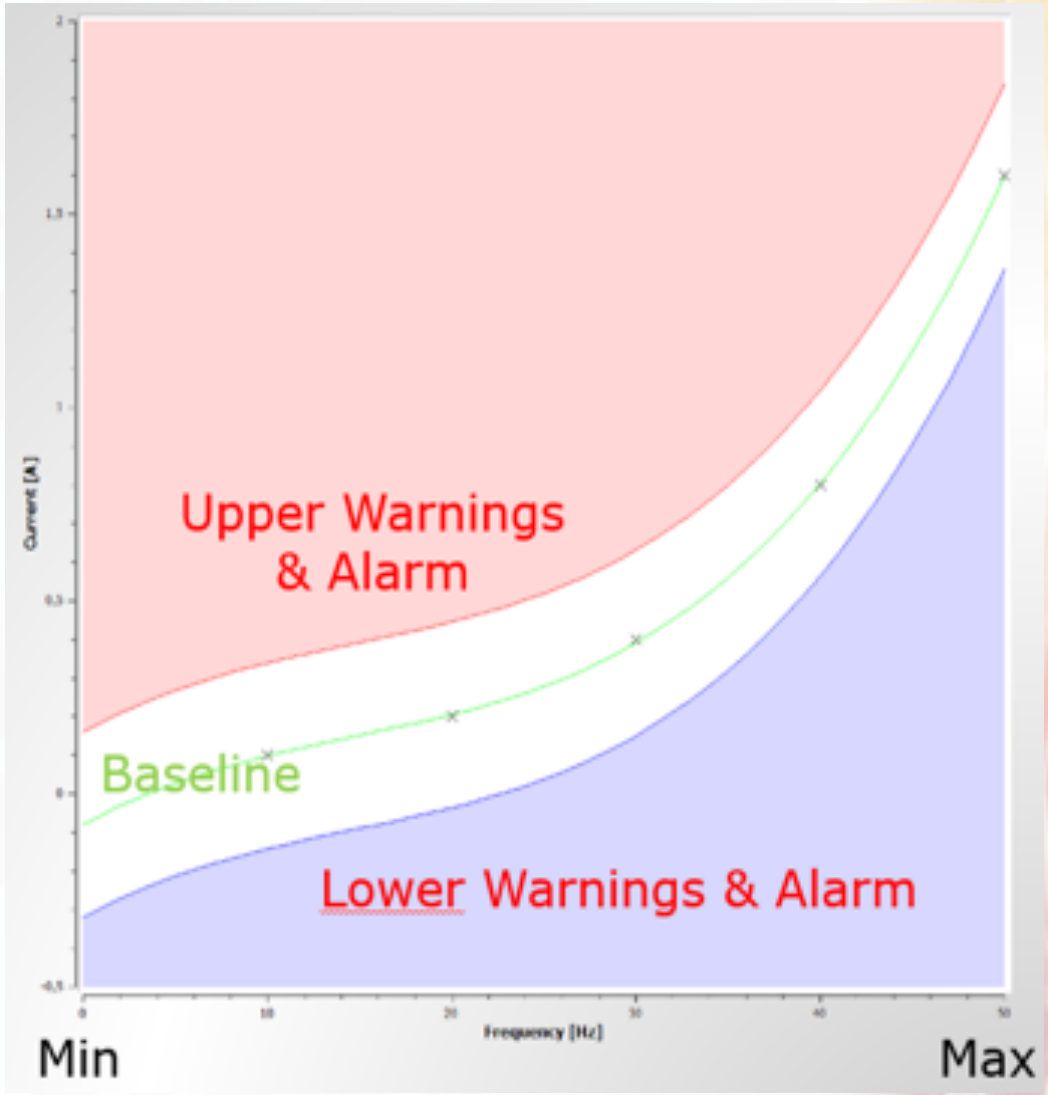
How does it work?



- The drive runs a ”baseline measurement” to learn the values of a “normal” application operation, from minimum speed to maximum speed.
- Two Warning levels (1 and 2) and an Alarm thresholds are created after running the baseline, with a “hysteresis” to the baseline.
- During operation, the actual values will be compared to the thresholds at the actual speed, and notification is provided when levels are exceeded.



Condition-Based Monitoring

Break-through technology implemented at drive's level:

- Stator winding monitoring
- Vibration monitoring
- Load envelope

How it works:

- Each function is represented by an analogue numeric value.
- The drive needs to run a "baseline measurement" to learn the values of a "normal" operation.
- Two Warning levels and alarm thresholds are created after running the baseline.
- During operation, the actual values are compared to the baseline.
- Indication - Notification after VDMA 24582

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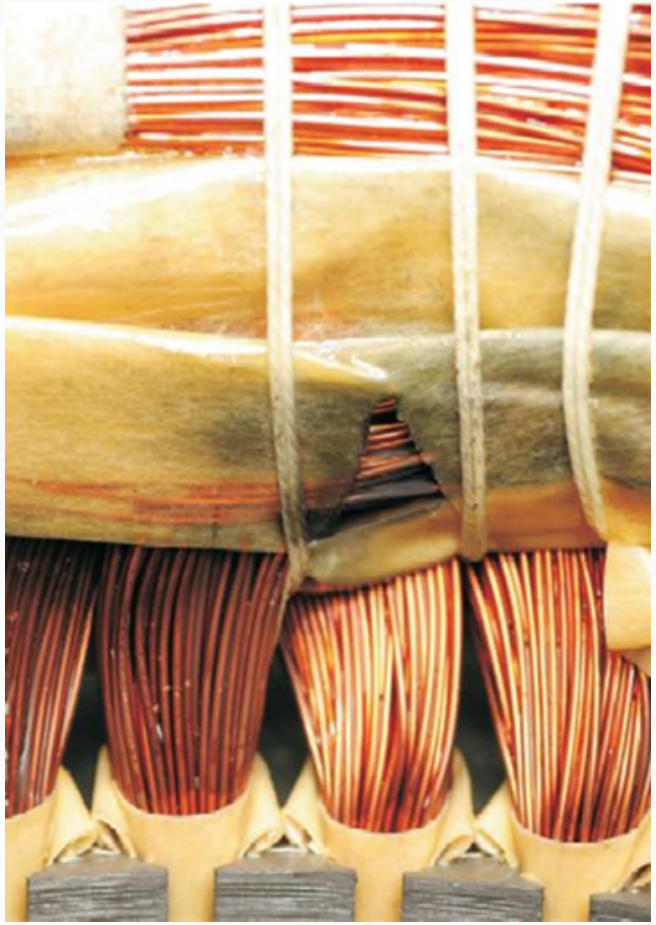
Motor stator winding monitoring

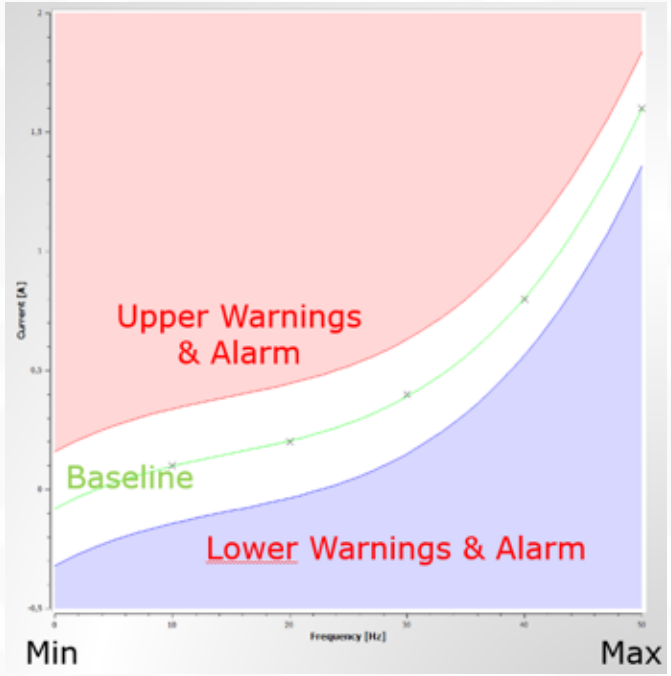


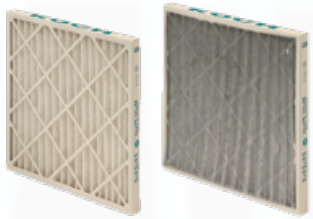
- By analysing the motor current signature, the drive can detect motor winding damage at early stage.
- This function does not require any external sensors.
- The monitoring function triggers an early warning in case the stator winding develops an insulation fault.
- Early warnings prevent motor-failures and unexpected downtime. And allow for planned maintenance and motor-replacements

Vibration monitoring (External Sensor)

- External vibration sensor (4…20 mA).
- Threshold level according to ISO10816.
- The function can be used to detect:
  - unbalance & eccentricity
  - looseness
  - misalignment
  - mechanical resonance
- Drive correlates vibration with motor speed.
- Permanent monitoring vs. occasional service checks.

Load Envelope





- The function learns the load curve of the application and detects whenever the load moves above or under the baseline level
- The function is useful fault detection in various applications with passive load:
  - Fouling, sanding, broken impeller or wear-out of pumps
  - Clogged filters, closed dampers and leakages in ventilation systems

Data Centre Case Studies

Data Centre (United States)

- Located in the western United States on an area the size of 26 football fields (140.000m^2), this Data Centre is part of the valuable infrastructure bringing applications and services to more than two billion people across the globe.
- This new Data Centre will be, upon completion, among the most advanced, energy and water-efficient facilities in the world, setting new standards for Data Centres in the world.
- The advanced high efficiency fan and drive technology make the solution state-of-the-art in terms of highest levels of efficiency and lowest TCO over an expected lifetime of 20+ years.

Equinix Data Centre (Netherlands)

- 135 AC Drives ensure that maximal Internet uptime is also cost-effective in the 6.000m2 Equinix Data Centre south of Amsterdam.
- Everything has to be just right; the temperature, the humidity, the quality of the mains voltage, the networks. All with a 100% guarantee that the equipment can continue running.
- The AC drives conserve lots of energy in the motor as a result of the reduction in revs, they also ensure that pumps achieve the highest possible hydraulic efficiency which has a substantial impact on the efficiency achieved by the overall installation. By running the pump in the correct curve, its service life is also extended.

Modular Cooling Units

- Managing Data Centre capacity and reliability is complex.
- By adapting the latest state-of-the-art technologies, such as oil-free magnetic bearing variable speed centrifugal compressors, high efficient AC Drives and latest technology heat-exchangers, into modular cooling units, at Data Centre facilities in North America, **Lenovo** enjoyed a saving of 80-90% on the power used for the cooling infrastructure. And significant savings on the water usage.
- The modular units are said to cost less than a traditional chiller plant and implement scalability to expand on an as-need basis without ever shutting the system down.

Qualcomm Data Center

A 1,400 ton chiller as part of a combined cooling and power requirement at a Qualcomm Data-Center gains the sustainable oil-free benefits and inherent redundancy of the magnetic bearing centrifugal compressors and qualify for the deepest utility rebates.

- Located in San Diego, California USA
- Chiller Retrofit using a 1400 Ton Chiller with oil-free magnetic bearings centrifugal compressors.

Results:

- Energy Consumption reduced by 30% but in some cases improved by as much as 50%

Conclusions

- AC Drives on Fans, Pumps and Compressors in Data Centres offer tremendous saving potential on energy consumption and equipment maintenance.
- Choosing the most efficient applications and solutions improve Data Centre energy efficiency significantly and bring very short pay-backs.
- Beneficial to deploy intelligent Heat Management to remove dissipated heat, e.g. Back Channel Cooling.
- Enhanced intelligence in latest generation AC Drives enables the drives to act as sensors and sensor hubs to process, store and analyze data.
- Condition Based Monitoring implemented at drive's level facilitates new functions which strengthen Data Centre reliability
  - Stator winding monitoring
  - Vibration monitoring
  - Load envelope monitoring

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