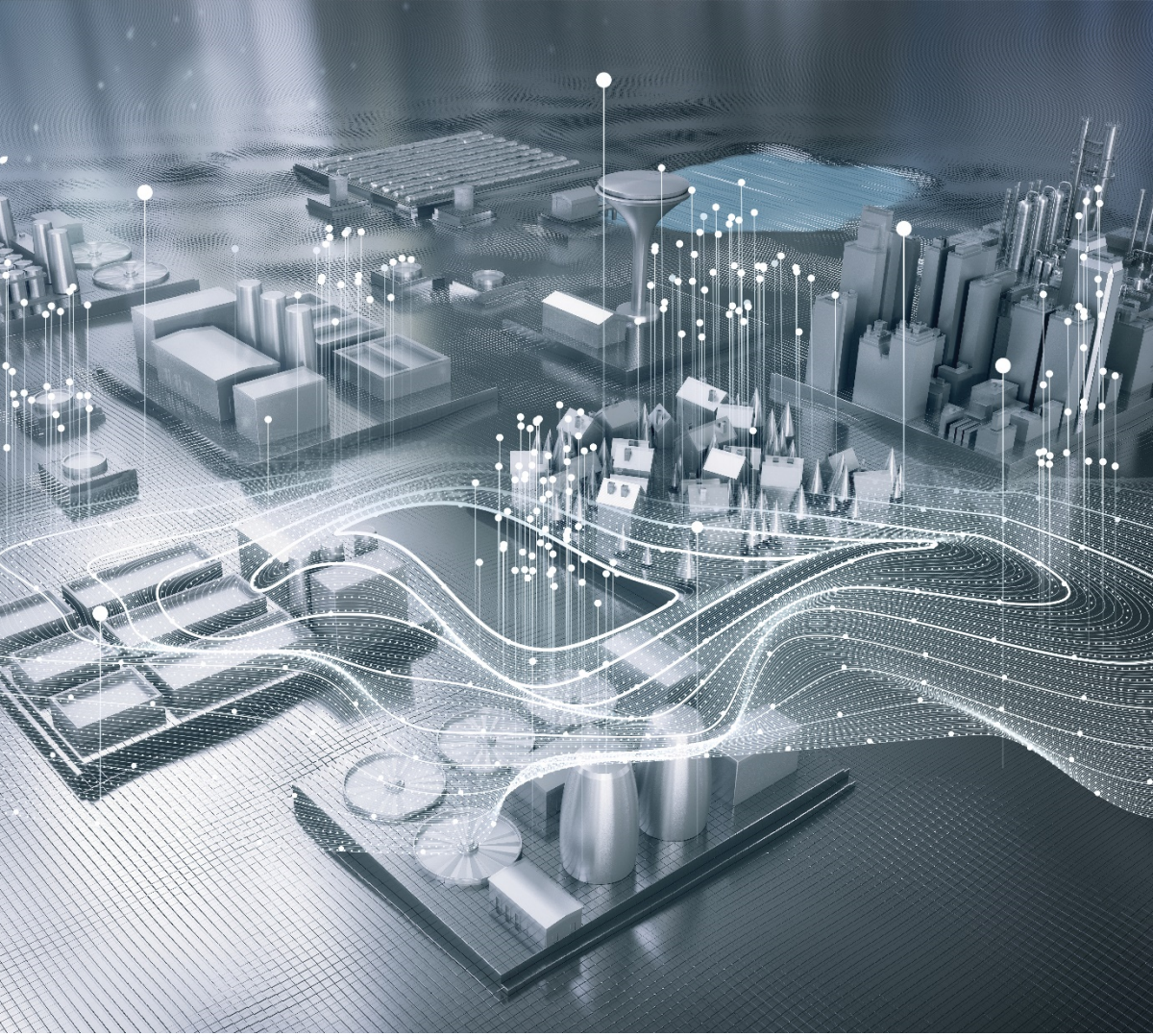




ENGINEERING
TOMORROW



Innovative STP Solutions by Danfoss Drives

NWC

06-12-2022

Ture Vahan Munksgaard &
Ibrahim Kamal

ENGINEERING
TOMORROW

Danfoss

Welcome to
Danfoss



“Danfoss has
never been
more relevant”

Kim Fausing





We engineer solutions that enable the
world to do more with less

We engineer tomorrow and build a better future

Our World

Danfoss Power Solutions



Construction



Industry



Forestry



Agriculture

Danfoss Climate Solutions



Residential Heating



Cooling



District Heating



Air Conditioning

Danfoss Drives



Industry



Brewery



Automotive



HVAC

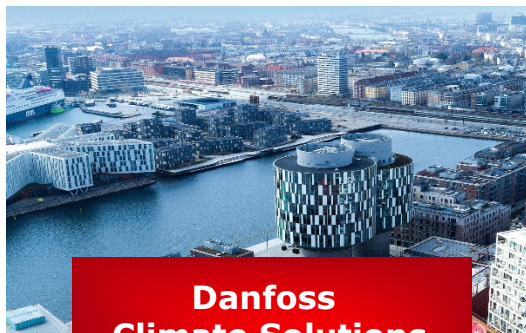
Our Segments



Danfoss Power Solutions

#2 Market position

- 19,061 employees
- 53 factories in 19 countries



Danfoss Climate Solutions

#2 Market position

- 11,235 employees
- 34 factories in 15 countries



Danfoss Drives

#2 Market position

- 4,582 employees
- 9 factories in 7 countries





Digitalization



Electrification



Urbanization

GLOBAL MEGATRENDS

Transforming our world



Food Supply & Water



Climate Change

Climate Change

- Greenhouse gases increased by 50% since 1990
- Energy efficiency and renewable energy only ways to a low-carbon world
- Energy efficiency deliver largest reductions in greenhouse gas

1.5°
Paris
agreement
goal

Urbanization

- Cities account for 60-80% of energy consumption and 75% of CO₂ emissions
- World population to reach 8.6 billion people in 2030
- By 2050, 70% will be living in cities

Energy

- 40% of global energy is consumed in buildings
- Representing 33% of global CO₂ emissions

Save
50%
with intelligent
control

Electrification

- Green energy will make electricity the largest energy carrier
- Increased need for storage capacity to deal with peak loads
- By 2040, 50% of all cars will be electric – ferries, trucks and other vehicles also going electric

Transport

- 20% of global energy is consumed by transport
- Representing 25% of global CO₂ emissions

7%

higher efficiency in
electric drivetrains

Food Supply & Water

- One third of all food is lost
- Food wastage is responsible for one third of all greenhouse gas
- Food production needs to increase 60% to feed the world's population in 2050

Supermarkets

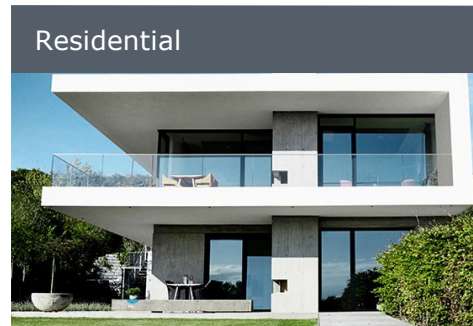
- Turn into heat suppliers
- 95% of excess heating supermarkets can be recycled

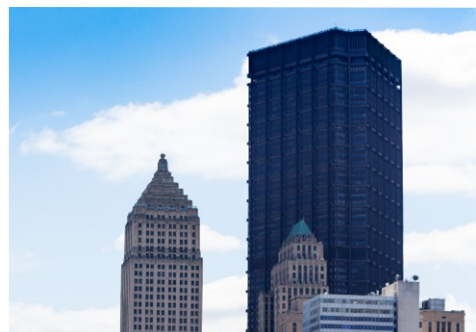
Save
43%
on carbon
footprint

Digitalization

- 90% of all data created in the past two years
- 1 million new devices coming online every hour
- Digitalization will drive customer value – eg. IoT will save USD 1 trillion in maintenance annually

**USD 1
trillion
saving
potential**







40%
Energy
savings



30%
Energy
savings



34%
Energy
savings



90%
Energy
savings

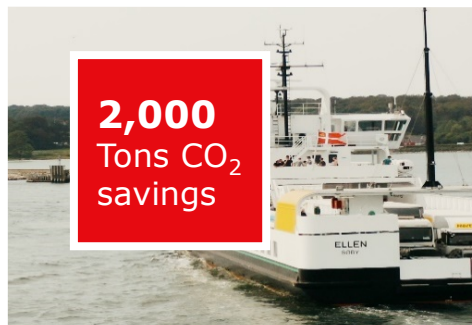


50%
Energy
savings



14,000
Tons CO₂
savings

The Green Transition



2,000
Tons CO₂
savings



20%
Energy
savings



100%
Carbon
reduction



1.1 mill
USD
savings



40%
Energy
savings

Saudi Green Initiative



Reducing Emissions



Target for Saudi Green Initiative

NET ZERO EMISSIONS 2060

Five initiatives under SGI will help to lower carbon emissions by more than 278 mtpa

كفاءة

المركز السعودي لكفاءة الطاقة
Saudi Energy Efficiency Center

وزارة الطاقة
MINISTRY OF ENERGY



2025

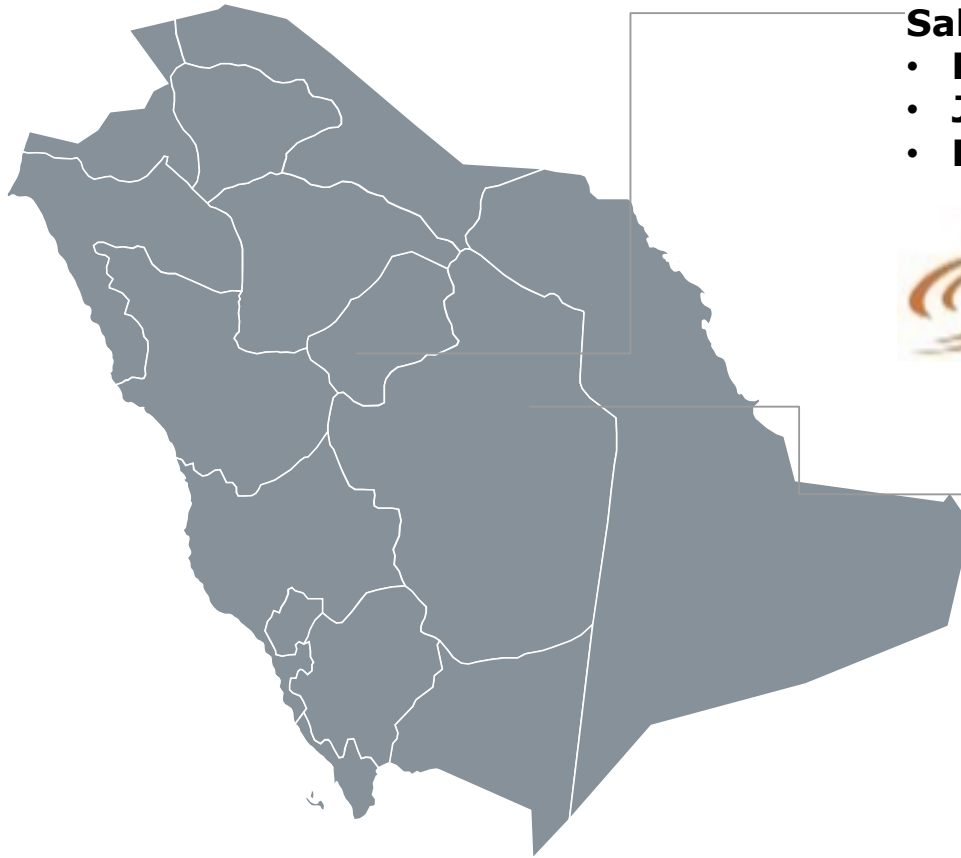
Enhance Saudi Arabia's Energy Efficiency Program (SEEP)

Implementing new energy efficiency standards in power generation, water desalination, and electricity transmission and distribution



Danfoss Saudi Arabia

Danfoss Drive Saudi Arabia Partners



Sahra Star
• Riyadh
• Jeddah
• Dammam



**Electronic
Component
Riyadh**





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Danfoss

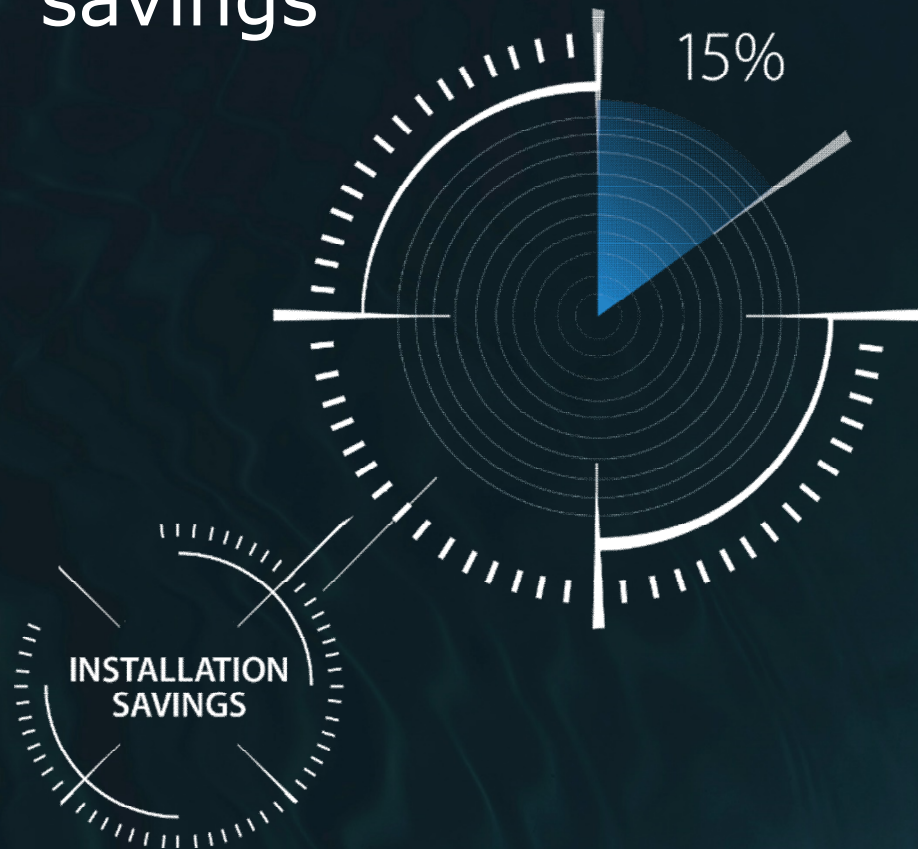
VLT® AQUA Drive FC 202 series for a **Masterclass Performance**

Ibrahim Kamal

Innovative solutions for savings

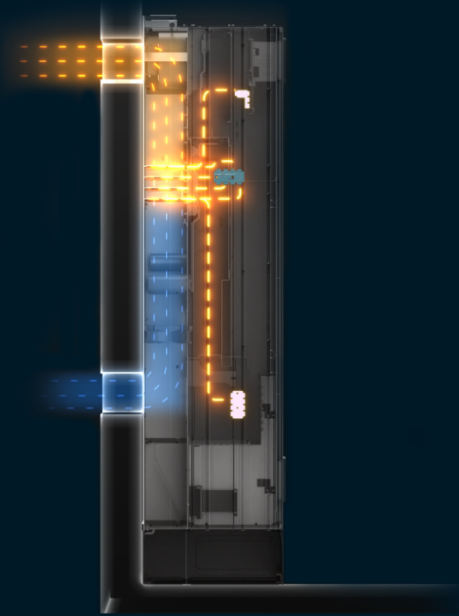
VLT® AQUA Drive offers cost installation savings up to 15% compared to traditional AC drives and more saving up to 50% for other solution with the following

- ✓ Unique heat transfer technology BCC
- ✓ Condition Base Monitoring
- ✓ Deragging
- ✓ Space-saving designs
- ✓ Standard long motor cables
- ✓ PCB protection
- ✓ Efficient solutions for Harmonic mitigation
- ✓ New digital cascade controller
- ✓ Extended temperature range
- ✓ Easy commissioning
- ✓ Smart Logic Controller
- ✓ Wireless/mobile device access



Back Channel Cooling & Heat Pipe system

Energy saving heat management



A unique back-channel cooling concept transfers up to 90% of heat away from the room, using a fan-less design that exploits heat differentials in materials and air temperature, and the latest developments in heat piping technology.

90%

Reduction in
energy use for
air conditioning



WATCH THE VIDEO

BACK-CHANNEL COOLING

HARMONIC MITIGATION

DERAGGING

ADVANCED MOTOR ADAPTION

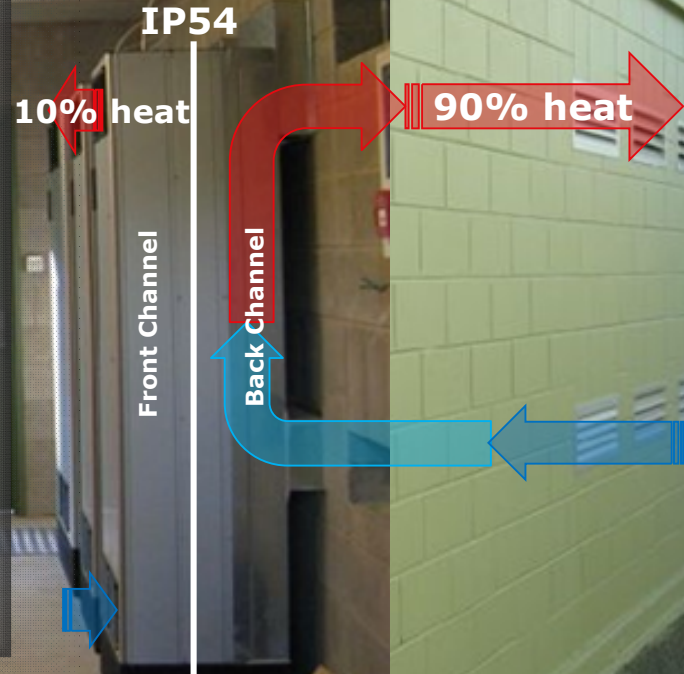
AUTOMATIC ADAPTION



Intelligent Heat Management

Back Channel cooling

- For VSD's Greater than 90kW
- IP54 seal between front & back channel
- 90% of the heat can be kept outside the control room, requiring less energy to control the control room temperature
- ✓ Temperature controlled fan
- ✓ Reduced switch room air-conditioning costs
- ✓ No dust on electronics



Trouble-free operation

Condition based monitoring



Unique solution

to improve
uptime

Cloud-free artificial intelligence embedded in the drive automatically defines operating baseline parameters corresponding to specific applications, at all speeds and real-life operating cycles. Reduced installation time and predictive maintenance lower operating costs and boost uptime.



WATCH THE VIDEO

CONDITION-BASED MONITORING

DERAGGING

DIGITAL CASCADE CONTROL

EASY ECESS OPERATION

HARMONIC MITIGATION

CUSTOMIZED LANGUAGE COMMUNICATION

PUMP PROTECTION

LONGER LIFETIME

Intelligent drives

Condition based monitoring



VLT® Condition based monitoring

Break-through technology implemented at **drive level**:

- Stator winding monitoring
- Vibration monitoring
- Load envelope

VLT® features that can be ordered in one 'package' as licensed software in:

- VLT® HVAC Drive FC 102
- VLT® Refrigeration Drive FC 103
- VLT® AQUA Drive FC 202
- VLT® Automation Drive FC 302

Condition-based monitoring

How does it work?



- Each function (motor winding, vibration and load monitoring) is represented by an analog numeric value.
- The drive needs to run a 'baseline measurement' to learn the values of a 'normal' operation.
- Two warning levels (1 and 2) and alarm thresholds are created after running the baseline.
- During operation, the actual values are compared to the baseline.

Condition based monitoring

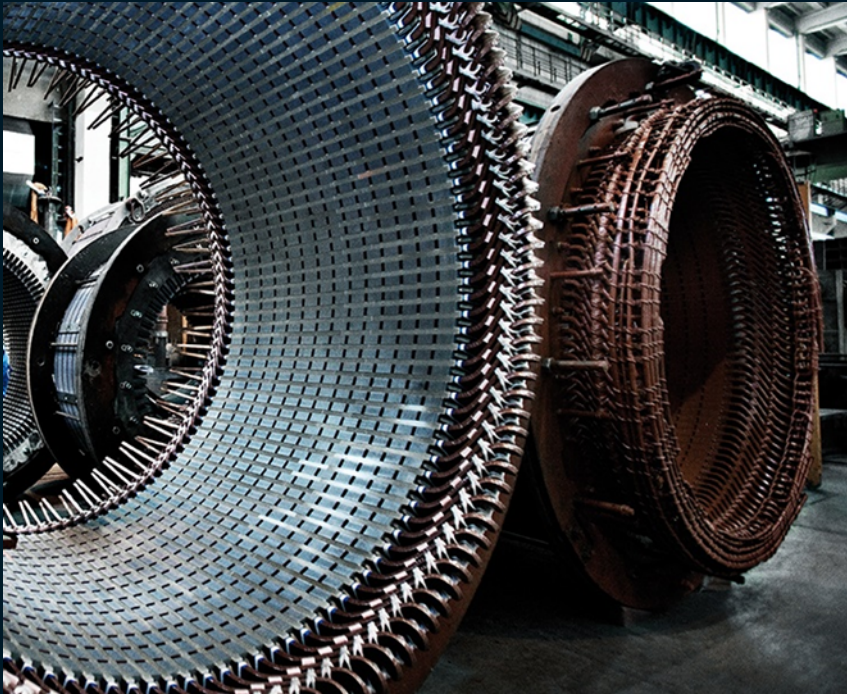
Vibration monitoring



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

Condition-based monitoring

Motor stator winding monitoring



- By analyzing the motor's current signature, the drive can detect motor winding damage at an 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
- Fault levels at 1% and 4%

Condition-based monitoring

Load envelope



- The function learns the load curve of the application and detects whenever the load moves above or under the baseline level
- Adds useful fault detection in various applications:
 - Fouling, sanding, broken impeller or wear-out of pumps
 - Friction in machines
- *Precondition is a reasonably constant relation between flow/speed and power over time at a given speed*

Condition-based monitoring

Load envelope



- Baseline is created over time, to cover different cycles
- Baseline measured in real life in the given application



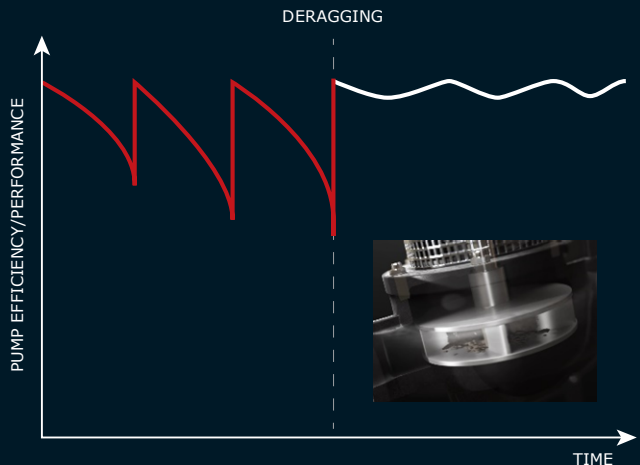
- Different alarm levels:
 - 10% – 10 sec
 - 20% – 10 sec
 - 65% – 10 sec

Condition-based monitoring

Key points we need to get across:

- This is super-advanced digitalization technology
- Danfoss is the first to introduce CBM imbedded in the drive
- No Cloud connection: Instead, machine learning and edge computing operate in the drive itself, presenting essential data to either Display , SCADA or Cloud – all within the drive
- It is unique: Create reference points:
 - Achieved without investment in new systems
 - Is in the specific application (when everything is installed and running)
 - Performs as function of speed – functions correlated with speed
 - Takes application specific cycles into account
- Cost effective solution (3-in-one + super low installation cost + no extra box or cables + no vibration of electronics)
- Will auto calculate band

Deragging for high pump efficiency



10-50%

energy saving,
based on
integrated
deragging
function

Embedded in the drive, the deragging function provides proactive maintenance with regular or clog triggered 'wash cycles' to keep impellers clean for consistently high pump efficiency.

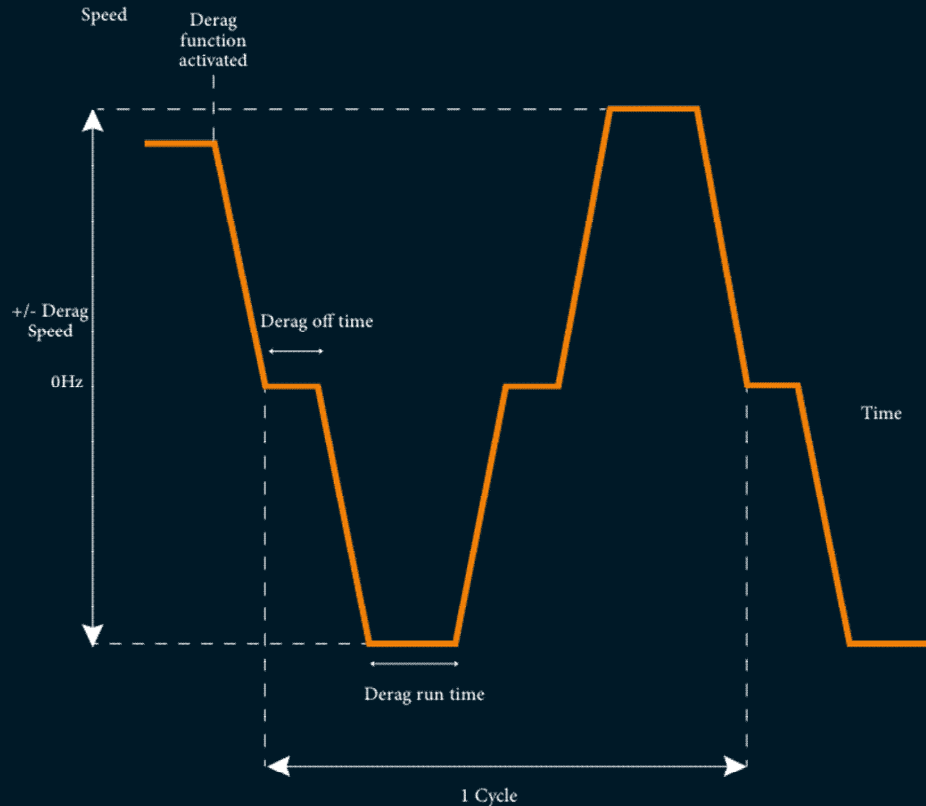


WATCH THE VIDEO

BACK-CHANNEL COOLING
HARMONIC MITIGATION
DERAGGING
ADVANCED MOTOR ADAPTION
AUTOMATIC ADAPTION



How Deragging function

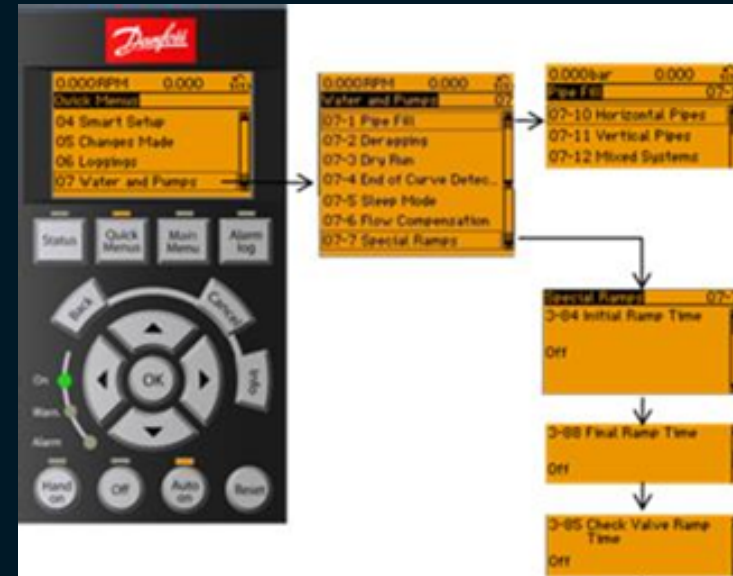


Running the pump in both direction.
for a number of cycles.
Configurable :
+ Number of cycles
+ Run time
+ Speed
+ Delay

DERAGGING

What trigger deragging function

1. Automatic detection
2. Timing
3. External control command



- **Case Stories**

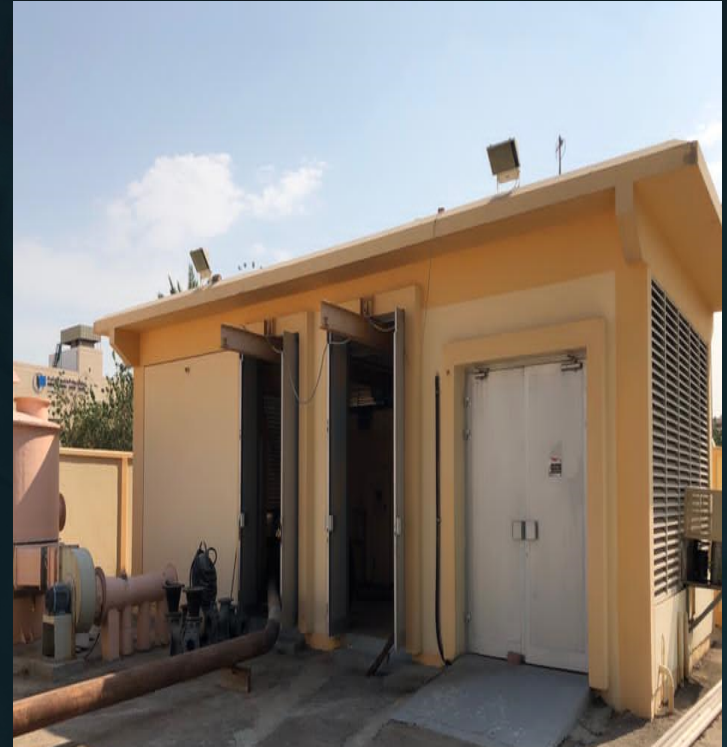
Case Story - Dammam "ALMubarqya Pumping Station "

Previous Situation:

- 1-2 times lifting per month in average
- Troubleshooting took 2-3 hours per lifting

Solution:

- Deragging with VLT Aqua Drive
- Triggered by Start/Stop command during alternation cycle of every 12 hrs



Case Story - Dammam "ALMubarqya Pumping Station "

Customer Value:

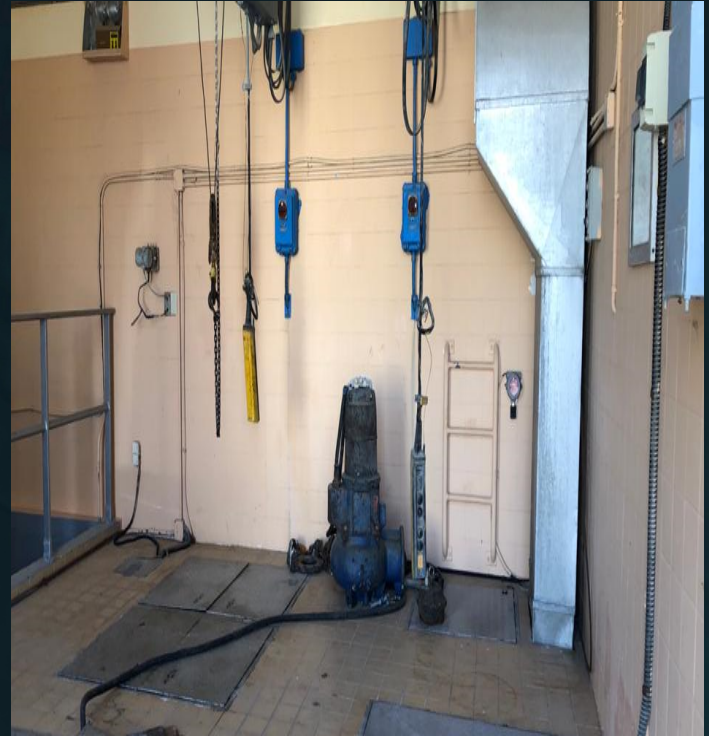
- ✓ No lifting anymore
- ✓ Solution without additional equipment

20,000

The annual saving is 20,000 SAR per pump

Annual savings:

- DOL / Traditional - 22 lifting /12 months.
- VFD - 2 lifting /12 months (Maintenance).
- Lifting cost
- Shut Down time cost
- Labour cost
- Damage and failure cost



Annual Saving & Payback

	Traditional System DOL/ Star Delta	Danfoss VFD - Deragging
Total number of lifts	22	2
Cost per lifting scope (with 4 staff)	SAR 1000	SAR 1000
Total cost for lifting per year	SAR 22000	SAR 2000
Saving per year in SAR	SAR 20,000	
Investment (VFD+ Panel + Installation) based on rating of 18.5Kw.	SAR 7,500.00	
Return on investment in months	4.5 Months only	

**AL-Kharj New STP– Riyadh
NWC
Danfoss VLT Aqua AC Drives
107 Drive 1.5KW up to 315kW**



**Shuaibah Water Desalination plant –
Jeddah
Shuaibah Water & Electricity Company
(SWE)
Vacon AC Drives
24 x 160kW - 250kW**





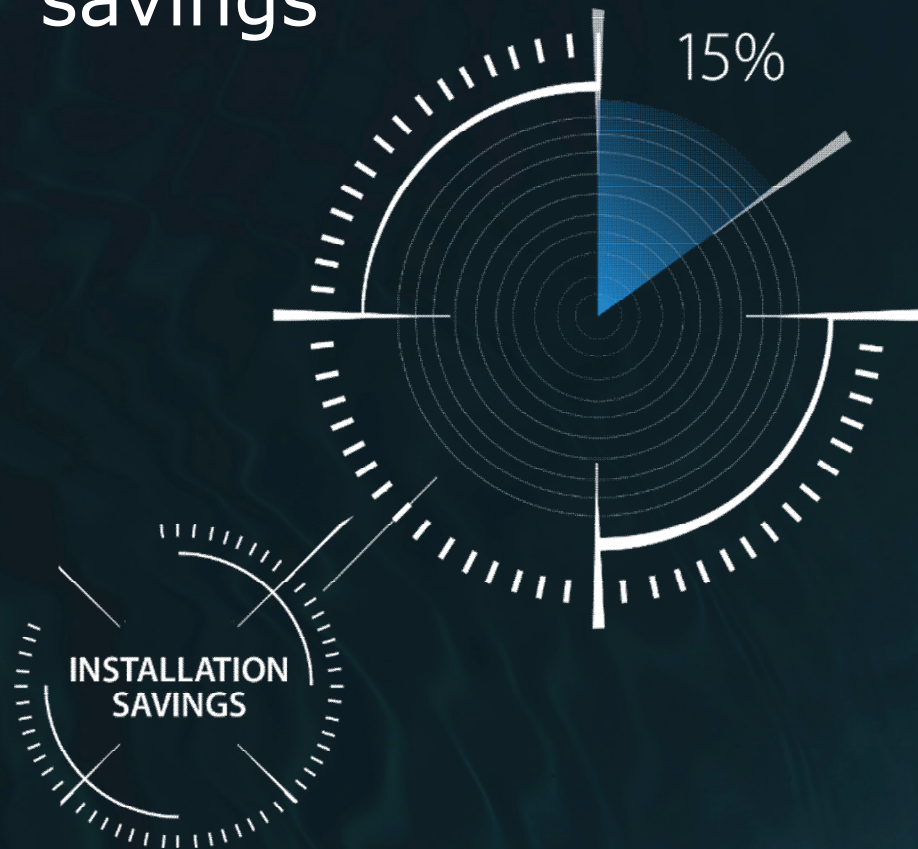


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Innovative solutions for savings

VLT® AQUA Drive offers cost installation savings up to 15% compared to traditional AC drives and more saving up to 50% for other solution with the following

- ✓ Unique heat transfer technology BCC
- ✓ Condition Base Monitoring
- ✓ Deragging
- ✓ Space-saving designs
- ✓ Standard long motor cables
- ✓ PCB protection
- ✓ Efficient solutions for Harmonic mitigation
- ✓ New digital cascade controller
- ✓ Extended temperature range
- ✓ Easy commissioning
- ✓ Smart Logic Controller
- ✓ Wireless/mobile device access



Installation savings

Less panel space



Up to
73%

more compact.
Highest power
density ever

Danfoss offers the highest power density in the market, which results in an unmatched compact design. Combined with side by side installation capability, the VLT® AQUA Drive delivers superior space saving drives solutions.

LESS PANEL SPACE

- DIRECT OUTDOOR INSTALLATION
- LONG CABLE CAPABILITY
- REDUCED AIR CONDITIONING
- CENTRAL HARMONIC MIGRATION
- CIRCUIT BOARD PROTECTION
- DIGITAL CASCADE CONTROL
- EASY COMMISSIONING
- EXTENDED TEMPERATURE
- SMART LOGIC CONTROLLER
- DERAGGING

Installation savings

Direct outdoor installation



NEMA 4X

Expanded
temperature
range

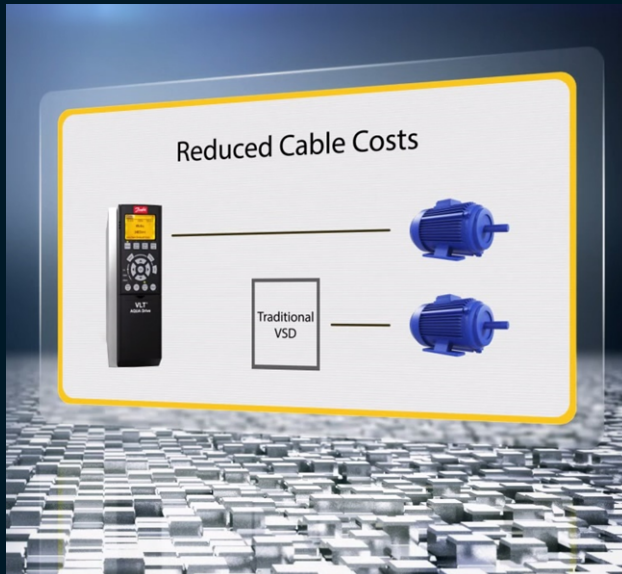
**-25°C to
+50°C**

As standard, Danfoss offers AC drives in IP66/NEMA 4X. In addition to the convenience of having the drive close to the pump, this typically reduces cable costs, removes the need for air condition capacity and lowers control room costs.

LESS PANEL SPACE
DIRECT OUTDOOR INSTALLATION
LONG CABLE CAPABILITY
REDUCED AIR CONDITIONING
CENTRAL HARMONIC MIGRATION
CIRCUIT BOARD PROTECTION
DIGITAL CASCADE CONTROL
EASY COMMISSIONING
EXTENDED TEMPERATURE
SMART LOGIC CONTROLLER
DERAGGING

Installation savings

Long cable capability

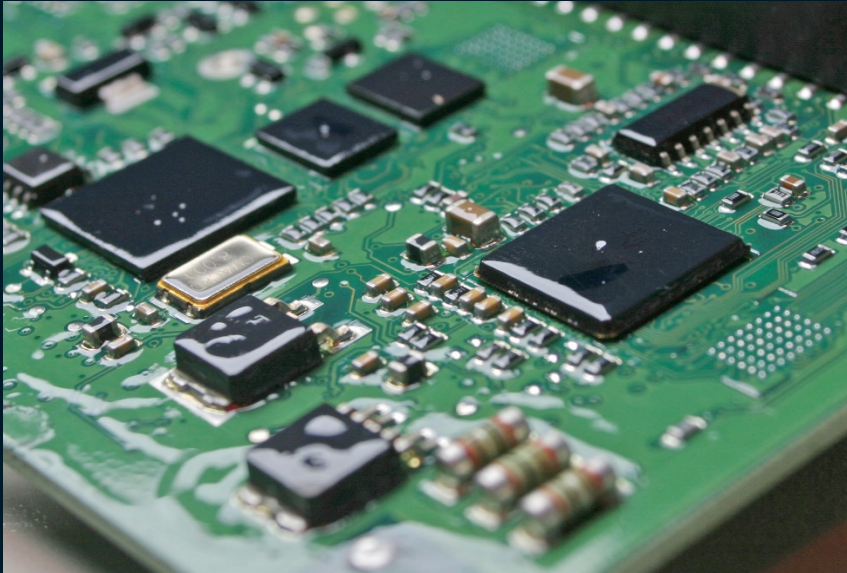


Without the need for additional components, the VLT® AQUA Drive provides flexible installation with cable lengths up to 150 m screened and 300 m unscreened to reduce installation costs.

- LESS PANEL SPACE
- DIRECT OUTDOOR INSTALLATION
- LONG CABLE CAPABILITY**
- REDUCED AIR CONDITIONING
- CENTRAL HARMONIC MIGRATION
- CIRCUIT BOARD PROTECTION
- DIGITAL CASCADE CONTROL
- EASY COMMISSIONING
- EXTENDED TEMPERATURE
- SMART LOGIC CONTROLLER
- DERAGGING

Installation savings

Printed circuit board protection as standard



Minimizing your installation costs, the VLT® AQUA Drive comes with 3C3 PCB coating as standard on 90 kW and larger drives to ensure long lifetime – even in harsh wastewater environments.

- LESS PANEL SPACE
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- CIRCUIT BOARD PROTECTION**
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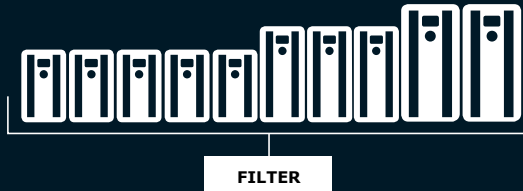
Installation savings

Space saving harmonic mitigation

Traditional solution



Danfoss solution



Up to
50%
more compact.
Easier
commissioning

The Danfoss central AAF solution for harmonic mitigation keeps installation costs down, while reducing the size of the drive cabinet to save space in the electrical control room.

- LESS PANEL SPACE
- DIRECT OUTDOOR INSTALLATION
- LONG CABLE CAPABILITY
- REDUCED AIR CONDITIONING
- CENTRAL HARMONIC MIGRATION**
- CIRCUIT BOARD PROTECTION
- DIGITAL CASCADE CONTROL
- EASY COMMISSIONING
- EXTENDED TEMPERATURE
- SMART LOGIC CONTROLLER
- DERAGGING

Installation savings

Digital cascade control



2-4

times reduced
cost, labor and
cable costs

- LESS PANEL SPACE
- DIRECT OUTDOOR INSTALLATION
- LONG CABLE CAPABILITY
- REDUCED AIR CONDITIONING
- CENTRAL HARMONIC MIGRATION
- CIRCUIT BOARD PROTECTION
- DIGITAL CASCADE CONTROL**
- EASY COMMISSIONING
- EXTENDED TEMPERATURE
- SMART LOGIC CONTROLLER
- DERAGGING

Daisy chain connected drives significantly reduce wiring complexity and cost. Embedded fieldbus communication protocol, makes commissioning easier than ever.

Trouble-free operation

Digital cascade control

Uptime focused unique cascade controller based on hot swap technology:

- 3 Cascade modes:
 - Standard mode
 - Mixed pumps
 - Master/follower
- Auto switch, if failure on follower drive
- Auto switch, if failure on master drive
- Auto switch, in case of loose connections or cable failure
- Auto setting of 'follower drives'
- Run-time balance

2-5

times faster
commissioning



CONDITION-BASED MONITORING -
DERAGGING -
DIGITAL CASCADE CONTROL -
EASY ECESS OPERATION -
HARMONIC MITIGATION -
CUSTOMIZED LANGUAGE COMMUNICATION -
PUMP PROTECTION -
LONGER LIFETIME -

Installation savings

Extended temperature range



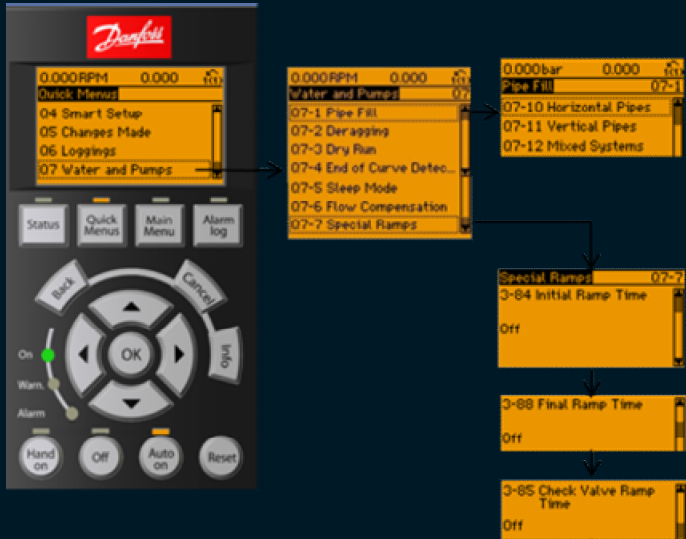
Unique
**-25°C to
+50°C**
temperature
range without
degrading

- LESS PANEL SPACE
- DIRECT OUTDOOR INSTALLATION
- LONG CABLE CAPABILITY
- REDUCED AIR CONDITIONING
- CENTRAL HARMONIC MIGRATION
- CIRCUIT BOARD PROTECTION
- DIGITAL CASCADE CONTROL
- EASY COMMISSIONING
- EXTENDED TEMPERATURE**
- SMART LOGIC CONTROLLER
- DERAGGING

VLT® AQUA Drives up to 315 kW operate in ambient temperatures from -25 to 50 degrees Celsius without derating.

Installation savings

Easy commissioning



Whether it's a 0.25 kW or a 1.4 MW drive you get the same control panel with local language, the new SmartStart function and many other time saving features, all wirelessly accessed on your mobile device to save you installation time and hassle.

- LESS PANEL SPACE
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- REDUCED AIR CONDITIONING
- CENTRAL HARMONIC MIGRATION
- CIRCUIT BOARD PROTECTION
- DIGITAL CASCADE CONTROL
- EASY COMMISSIONING**
- EXTENDED TEMPERATURE
- SMART LOGIC CONTROLLER
- DERAGGING

Installation savings Smart Logic Controller



Driving down your installation costs, the integrated micro PLC functionality saves you the need for investing in an external PLC and IO module.

- LESS PANEL SPACE
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- LONG CABLE CAPABILITY
- REDUCED AIR CONDITIONING
- CENTRAL HARMONIC MIGRATION
- CIRCUIT BOARD PROTECTION
- DIGITAL CASCADE CONTROL
- EASY COMMISSIONING
- EXTENDED TEMPERATURE
- SMART LOGIC CONTROLLER**
- DERAGGING

Trouble-free operation

Wireless/mobile device access



The unique LCP 103 display offers programming and supervision wirelessly via mobile device, offering easy and trouble free access to the VLT® AQUA Drive*

*Europe, India and US market (Q4, China, Russia, Australia, Argentina, Chile, Columbia, Indonesia, Taiwan, Thailand)

- CONDITION-BASED MONITORING
- DERAGGING
- DIGITAL CASCADE CONTROL
- EASY ECCESS OPERATION**
- HARMONIC MITIGATION
- CUSTOMIZED LANGUAGE COMMUNICATION
- PUMP PROTECTION
- LONGER LIFETIME

Trouble-free operation

Wireless/mobile device access



With our customization options you can make the drive communicate in the specific application terminology that your operators use. This will make it easy for service technicians to understand messages and alarms, reducing trouble-shooting time and increasing system uptime.

- CONDITION-BASED MONITORING
- DERAGGING
- DIGITAL CASCADE CONTROL
- EASY ECESS OPERATION
- HARMONIC MITIGATION
- CUSTOMIZED LANGUAGE COMMUNICATION**
- PUMP PROTECTION
- LONGER LIFETIME

Trouble-free operation

Application and pump protection features

The VLT® AQUA Drive has a number of features dedicated to water applications that increase uptime, including water hammer reduction, no flow and dry-run protection and advanced minimum speed monitor for protection of deep well pumps.

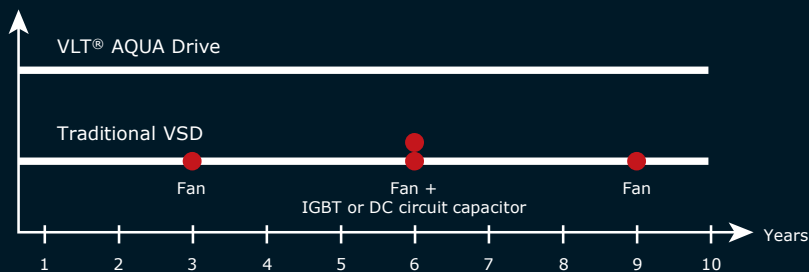


- CONDITION-BASED MONITORING
- DERAGGING
- DIGITAL CASCADE CONTROL
- EASY ECESS OPERATION
- HARMONIC MITIGATION
- CUSTOMIZED LANGUAGE COMMUNICATION
- PUMP PROTECTION**
- LONGER LIFETIME

Trouble-free operation

Designed for a minimum of 10 years' lifetime

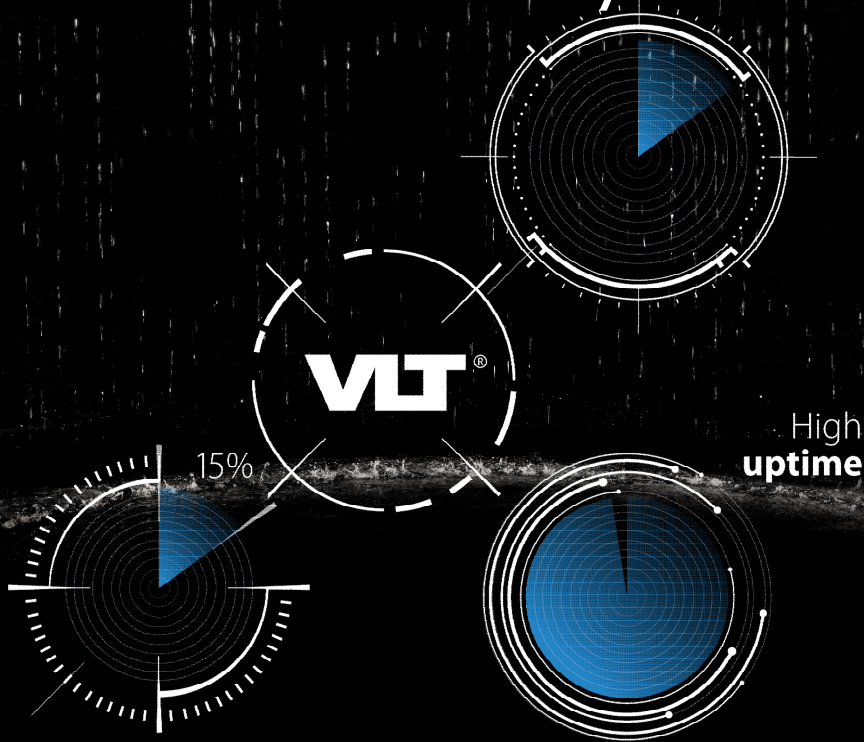
**Designed for a minimum 10 years operation
without routine replacement of parts**



With the VLT® AQUA Drive's high quality components, maximum 80% load on components and intelligent heat management minimizing dust on PCBs, the need for routine scheduled parts replacements, such as electrolytic capacitors and fans has been removed.

- CONDITION-BASED MONITORING
- DERAGGING
- DIGITAL CASCADE CONTROL
- EASY ECESS OPERATION
- HARMONIC MITIGATION
- CUSTOMIZED LANGUAGE COMMUNICATION
- PUMP PROTECTION
- LONGER LIFETIME**

A masterclass performance in installed savings, installed efficiency and trouble-free operation



A better tomorrow is
driven by drives