

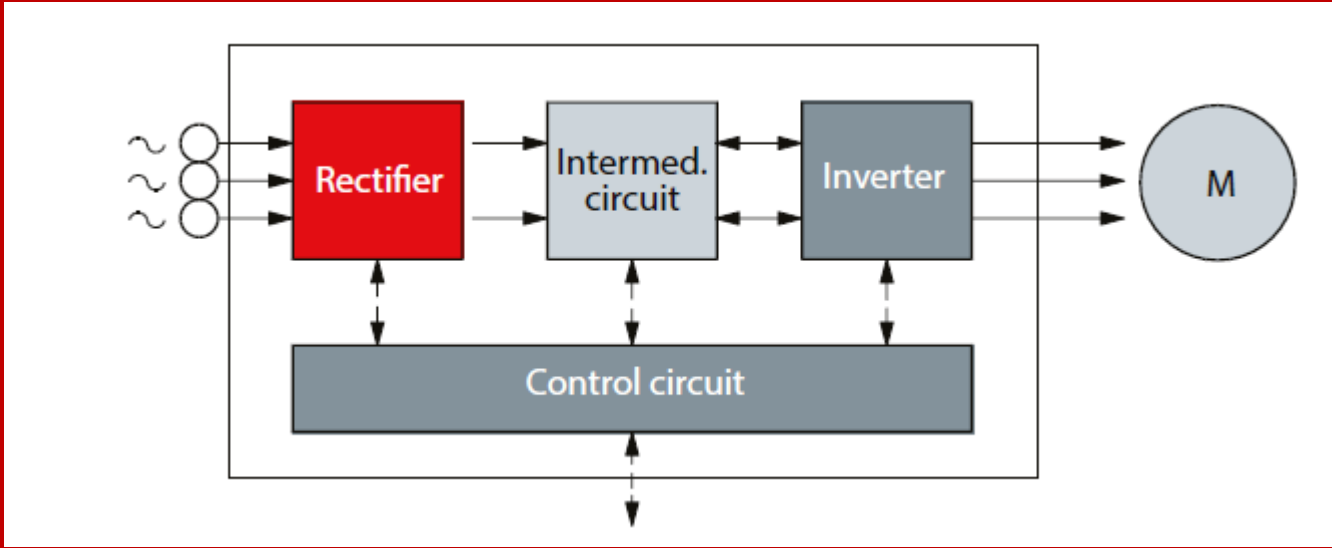
Why Use VFDs?

Dave Meglio

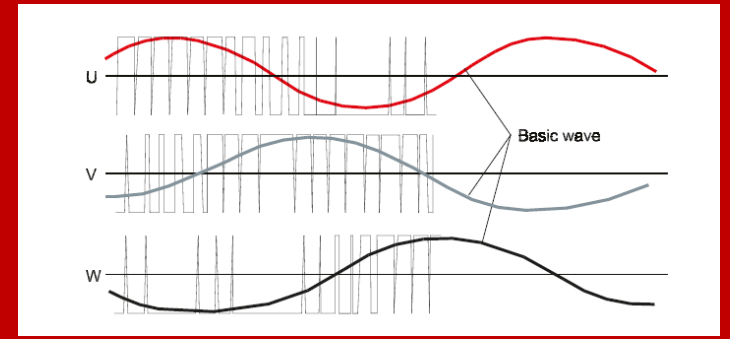
Meglio & Associates

Danfoss Representative

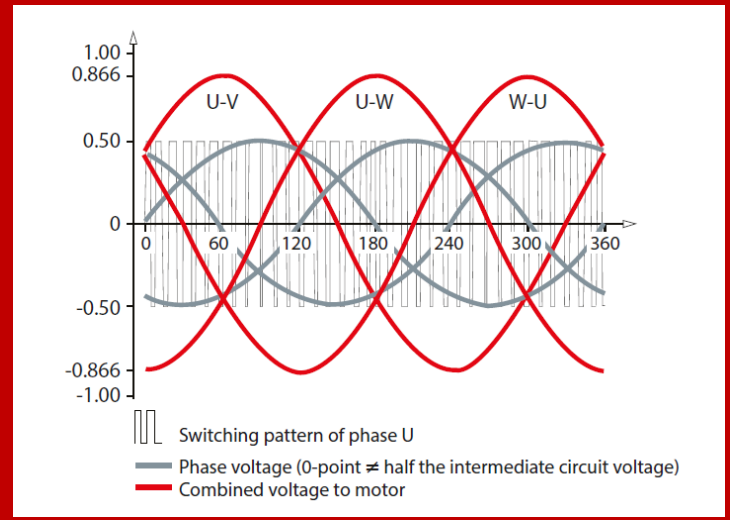
SIMPLIFIED DRIVE THEORY



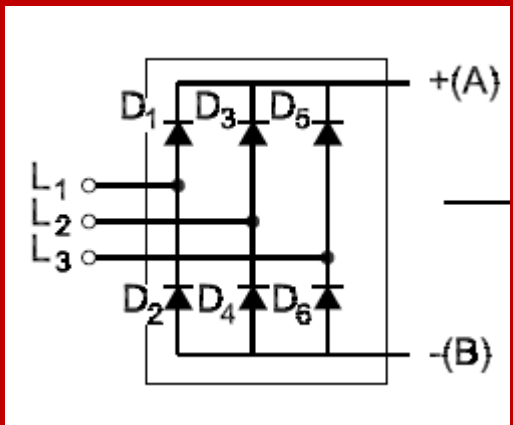
Speed Control of a Motor



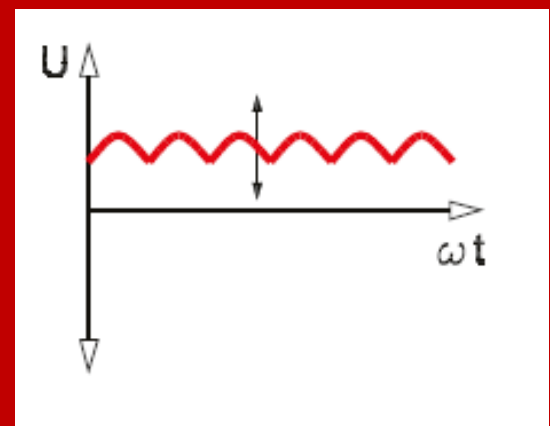
Inverter Section - PWM



Rectifier Section



Intermediate Circuit - DC Bus



How the VFD has Changed



Danfoss was the First Manufacturer to mass produce VFD's

VLT[®] 5 in **1968**

VLT[®] 200 in **1982**

VLT[®] 3000 in **1989**

VLT[®] 3500 in **1992**

VLT[®] 5000, 6000 and 8000 in **1997**

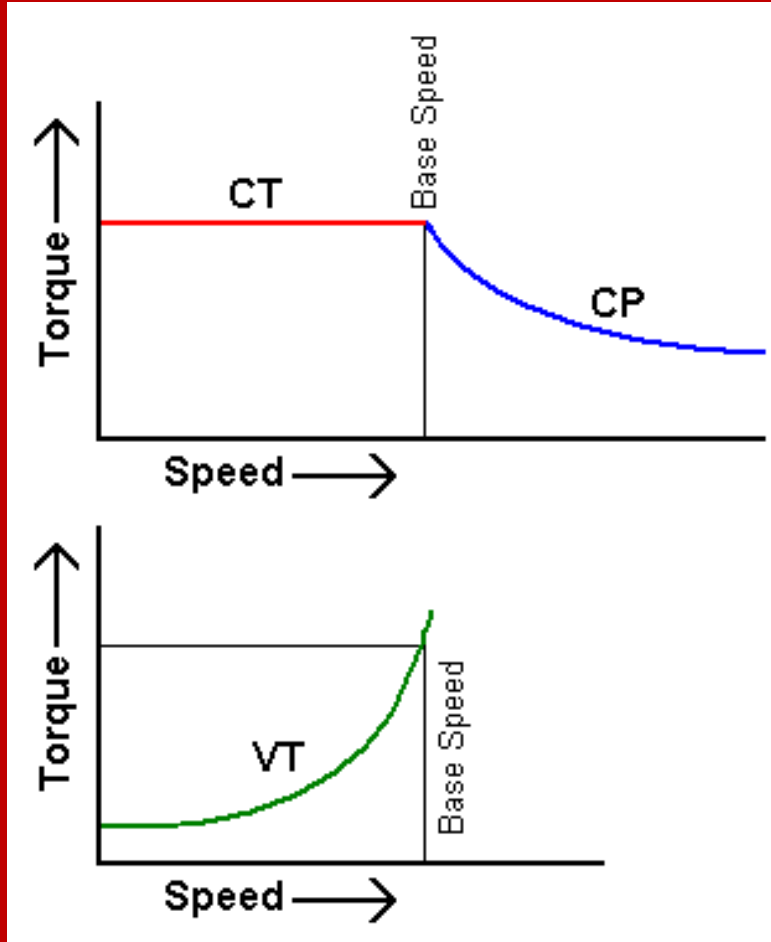
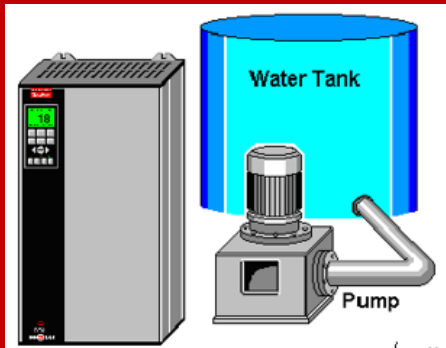
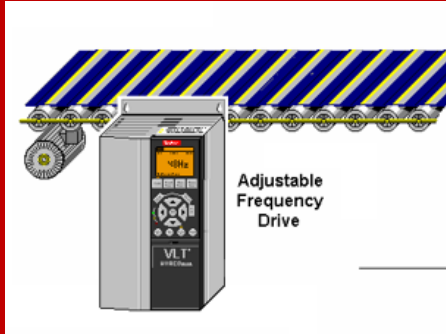
VFD's Can Help!

- 1. Reduce Energy Costs**
- 2. Better System Control**
- 3. Reduced Maintenance**
- 4. Bypass capabilities**
- 5. Protect the System**

Different Names for a VFD

- Variable Frequency Drive (VFD)
- Adjustable Frequency Drive (AFD)
- Inverter
- Adjustable Speed Drive (ASD)
- Variable Speed Drive (VSD)
- Frequency Converter
- AC Drive
- ...or just plain “Drive”

Application Torque Curves



CT = Constant Torque

- Conveyors
- Machinery
- Any High Inertia Load

VT = Variable Torque

- Pumps
- Fans

Torque Requirements of Both Styles:

-- Variable Torque: 110%

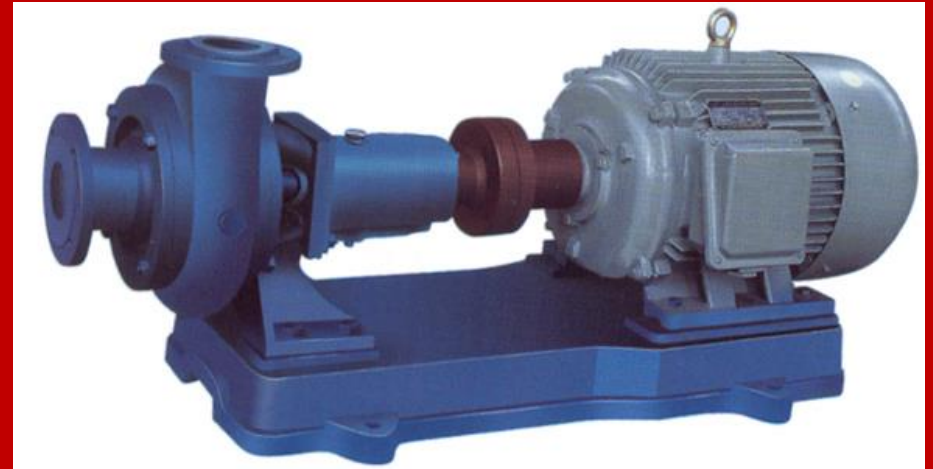
-- Constant Torque: 150%

1. VFD's Reduce Energy Costs

- A **20%** Reduction in Speed Yields a **50%** reduction in energy costs.

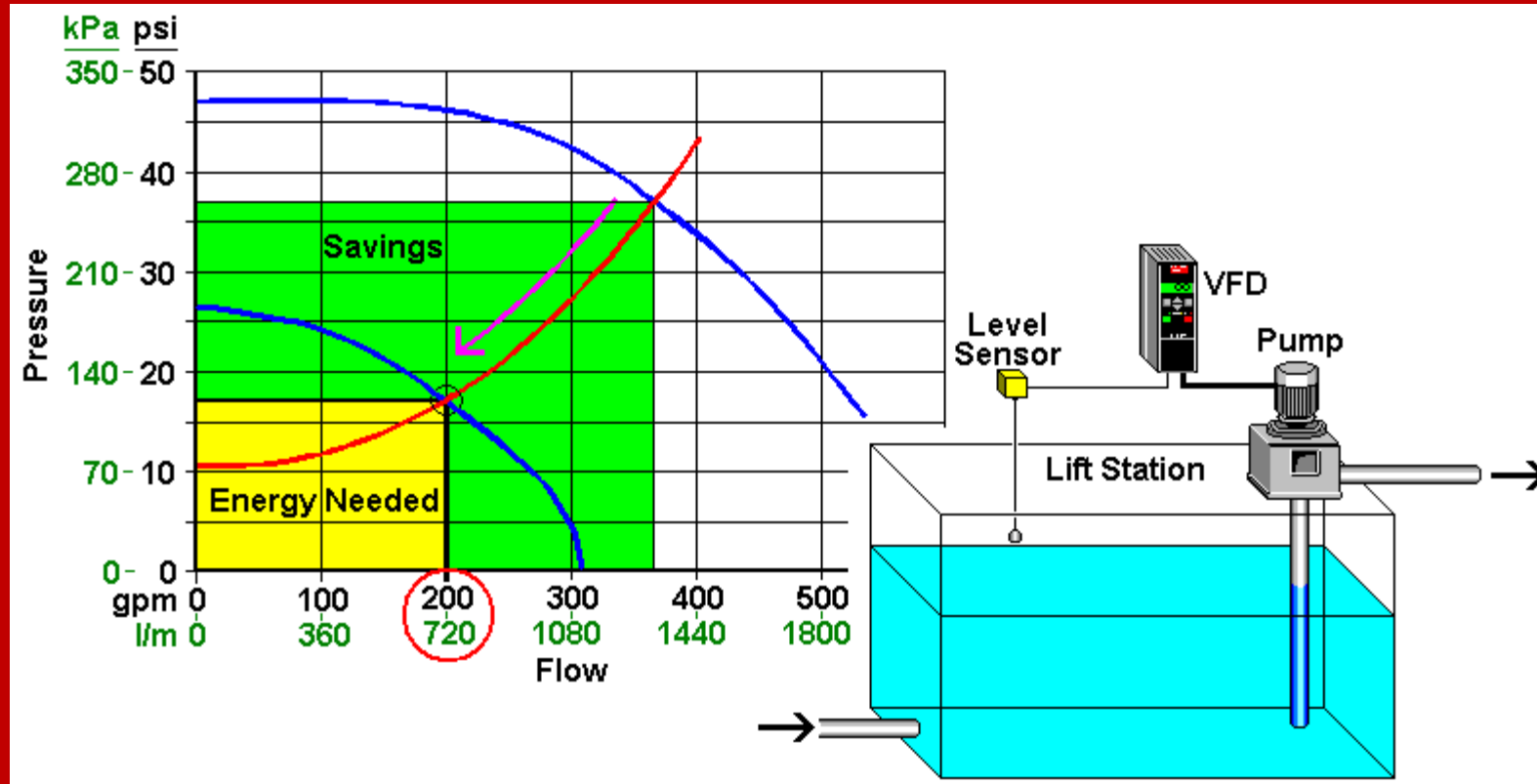
(Affinity Laws or Cube Root Law)

VFD's are used to Control Flow Of Air or Fluids



- **Water & Air Systems are designed for the**
 - **“Worst Case” situations.**
 - **Most of the time they have excess capacity.**

Controlling Flow Saves Energy



- Use a VFD to control the System flow
- Pump or Fan rides down the system curve
- **Saving Energy**

Reduced Peak Demand Charges

- VFDs reduce starting currents from 6 to 10 times
- VFD's ramp up loads gradually





**OLIN BRASS
200hp
PUMP
PROJECT**



HOLCIM CEMENT

(Bloomsdale MO)

● CASE STUDY THREE

< 2 years

payback on VFD installation

The newly installed Danfoss VLT® variable frequency drives slashed Holcim's utility bills so much that the project payback period was less than 2 years.

CEMENT PLANT ACHIEVES

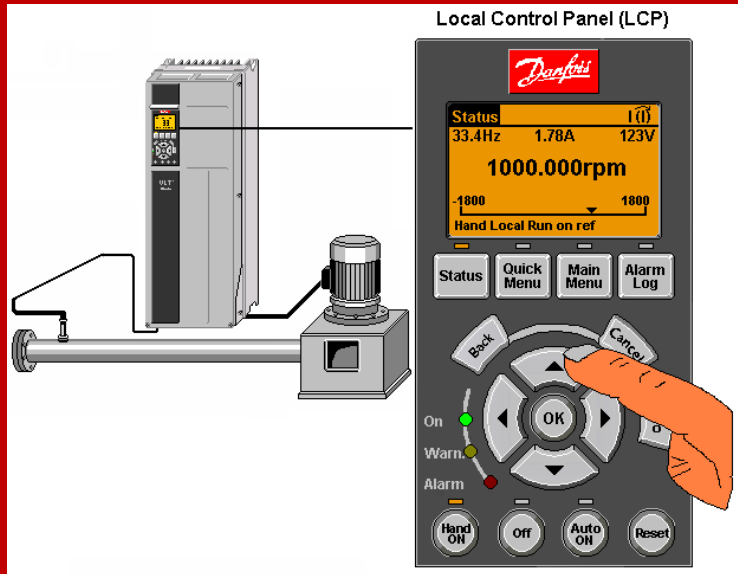
Solid Energy Savings with VLT® Drives

HOLCIM SITE – BLOOMSDALE MO

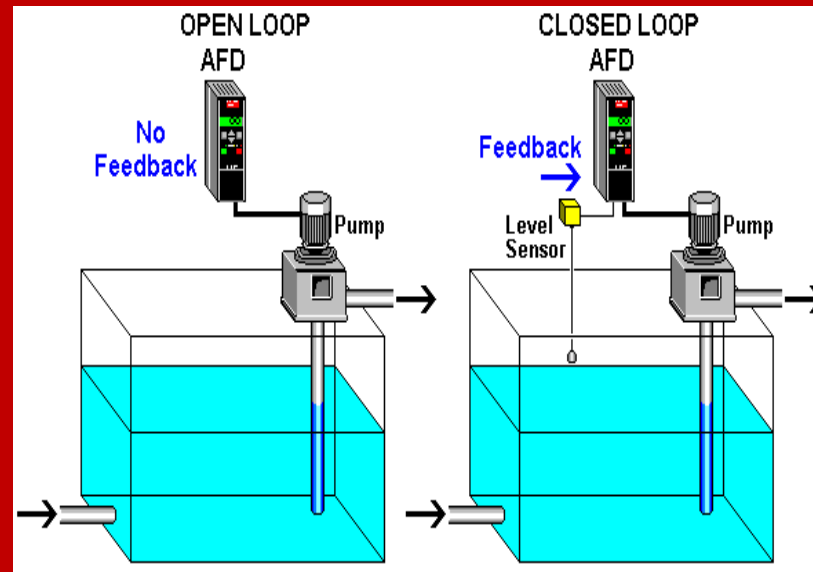


2. Better System Control

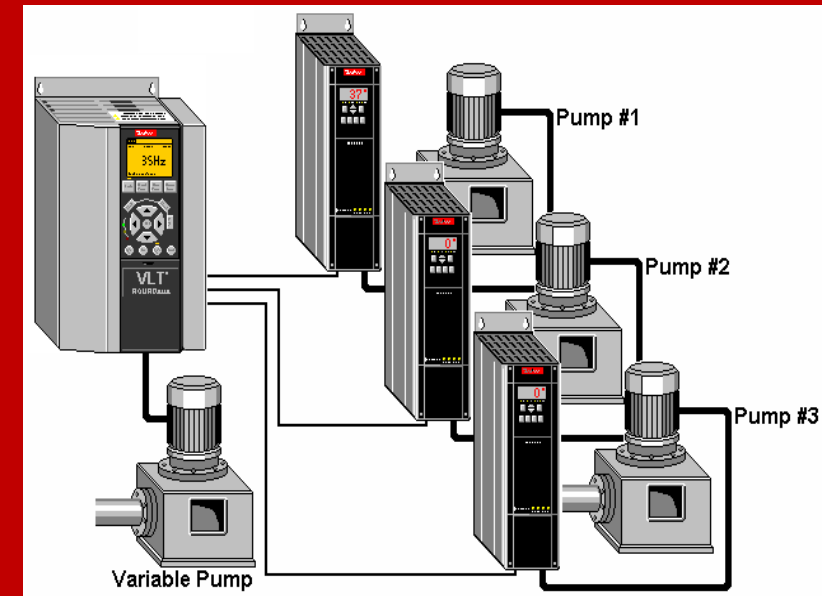
Local Control Panel



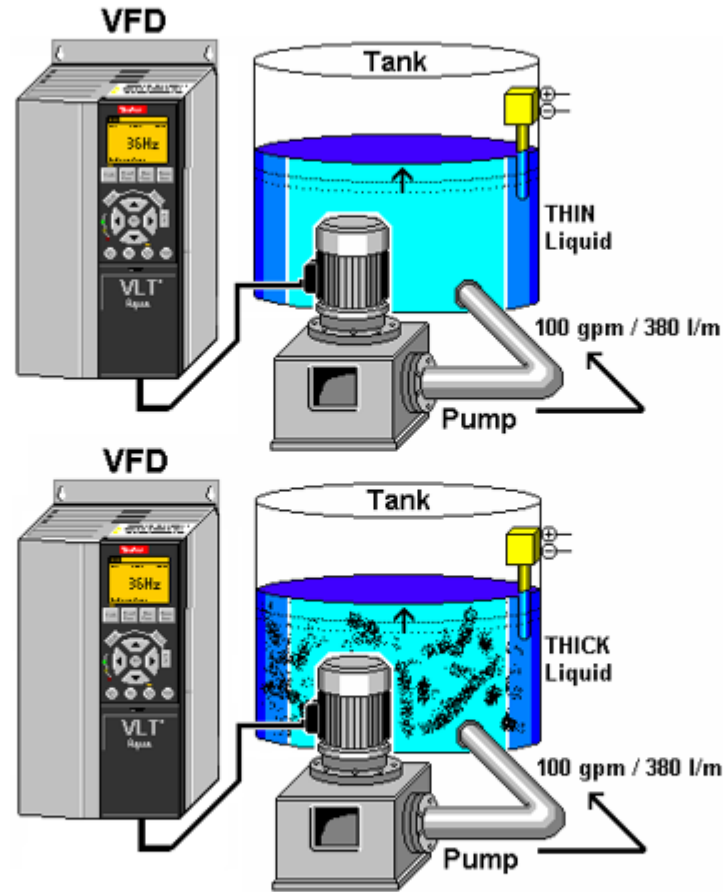
Open or Closed Loop



Motor Alternation

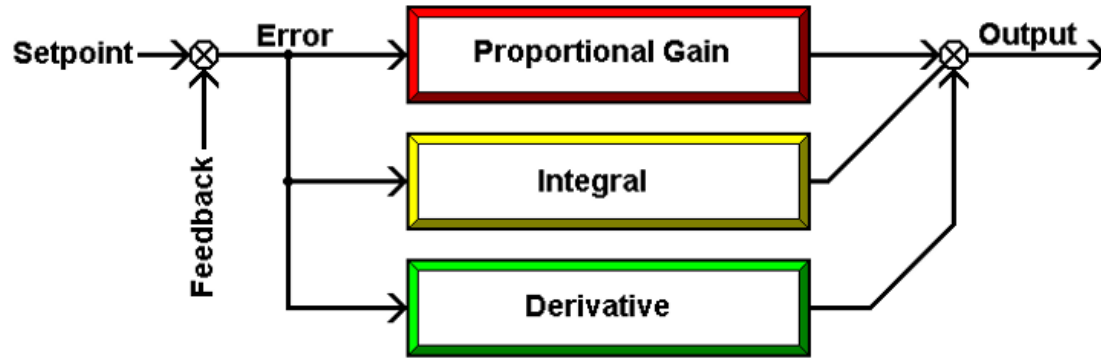


Drives Maintain Constant Speed



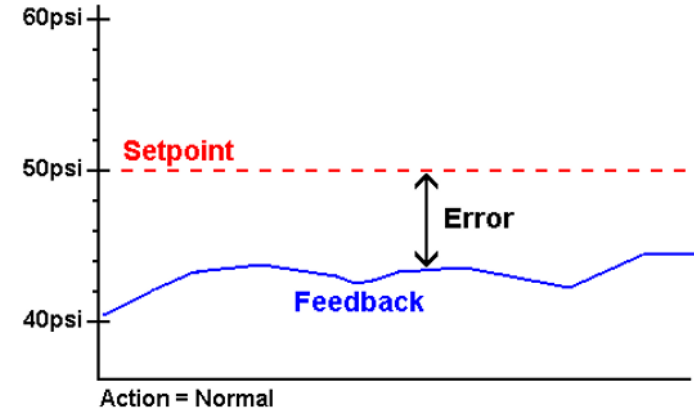
Light load or heavy, the drive should maintain the same speed.

PID ALGORITHMS

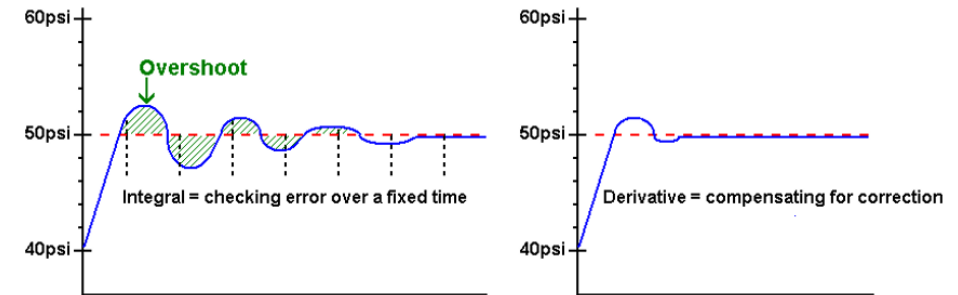


Summary: There are many different PID algorithms. All contain these 3 features, **Proportional Gain**, **Integral**, and **Derivative**. The ways these terms are combined may be different.

Proportional Gain



Integral & Derivative

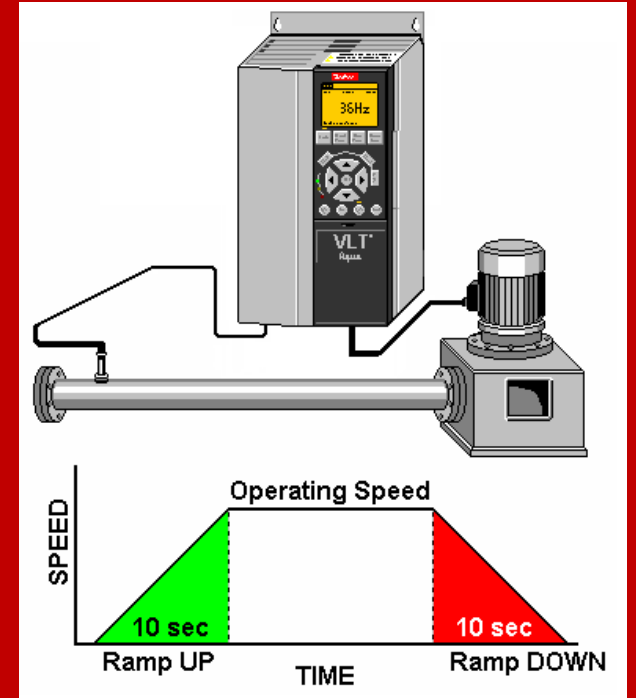


Additional benefits of Improved Control

- VFD's can go from **0 – 200% of base motor speed.**
- VFDs have an **infinitely adjustable speed range**

3. Drives Reduce Maintenance Costs

- **Controlled Ramps Help:**
 - Belts Last Longer
 - Reduced Line Stresses:
 - Water Hammer
 - Breaking Pipes
- **Motor Life is Increased by:**
 - Balancing Voltage when Line Voltage is not Balanced.



Drives Reduce Maintenance Costs

Mechanical devices such as:

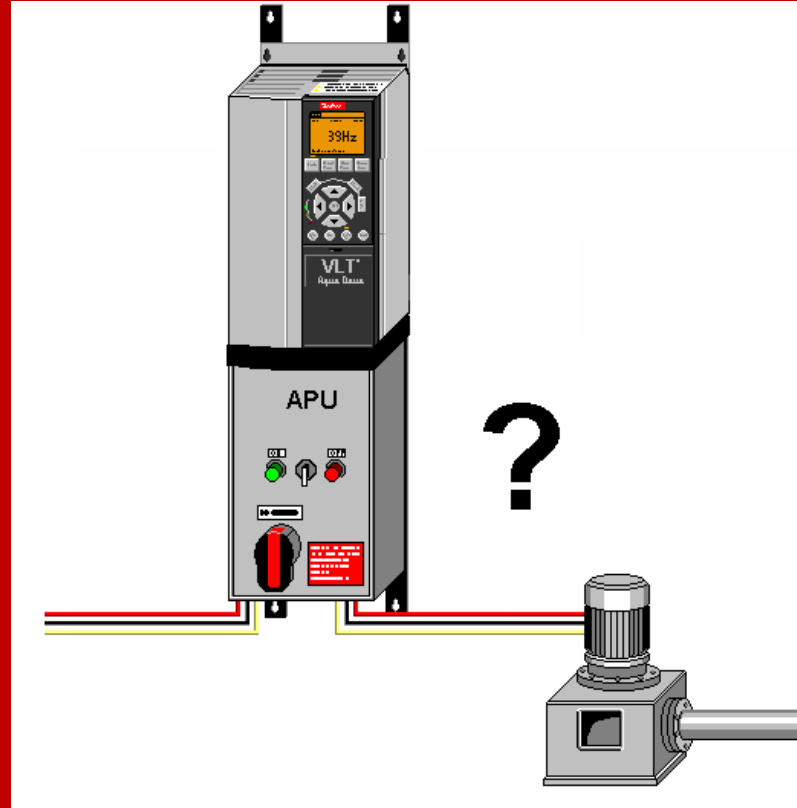
- Dampers,
- Modulating Valves
- Inlet guide vanes

All require regular maintenance; replacing these devices with VFDs eliminates all the routine maintenance associated with them

Filters Maintenance:

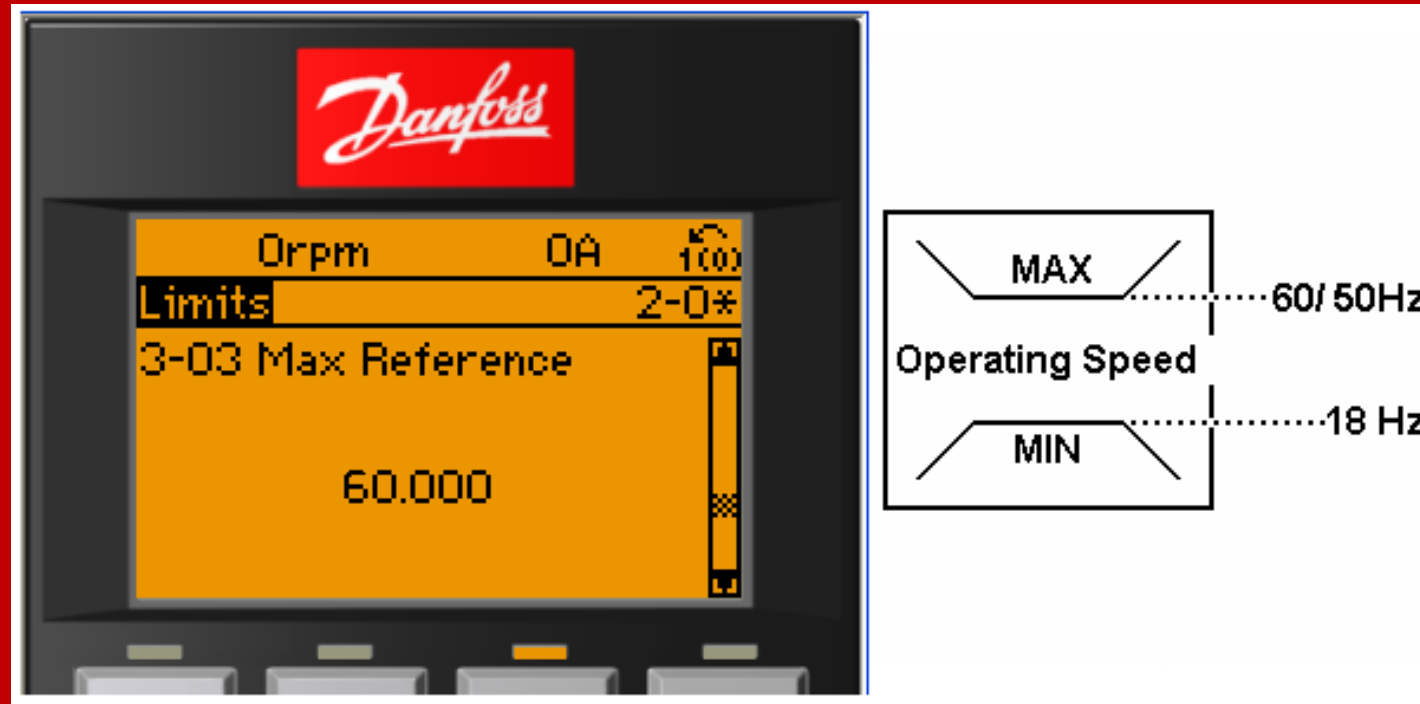
- Drives can tell you when it is time to change them.

4. Bypass Capability



Allows the Operator to Switch to Across the Line Control when Maintenance of the VFD is Performed.

5. VFD's Protect the Motor and Itself

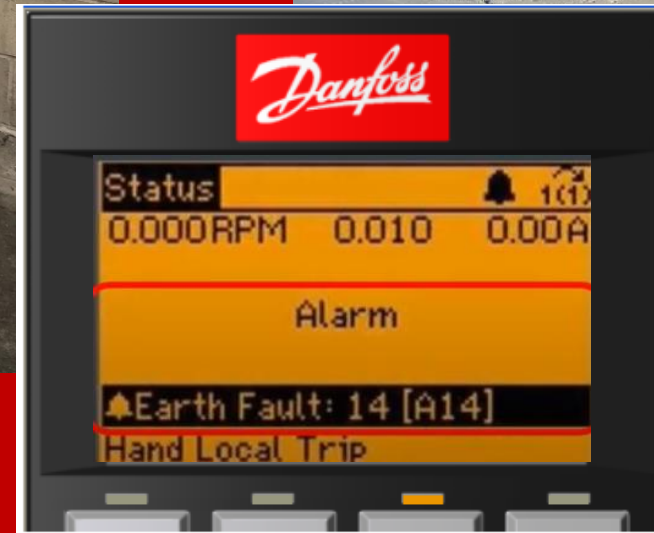
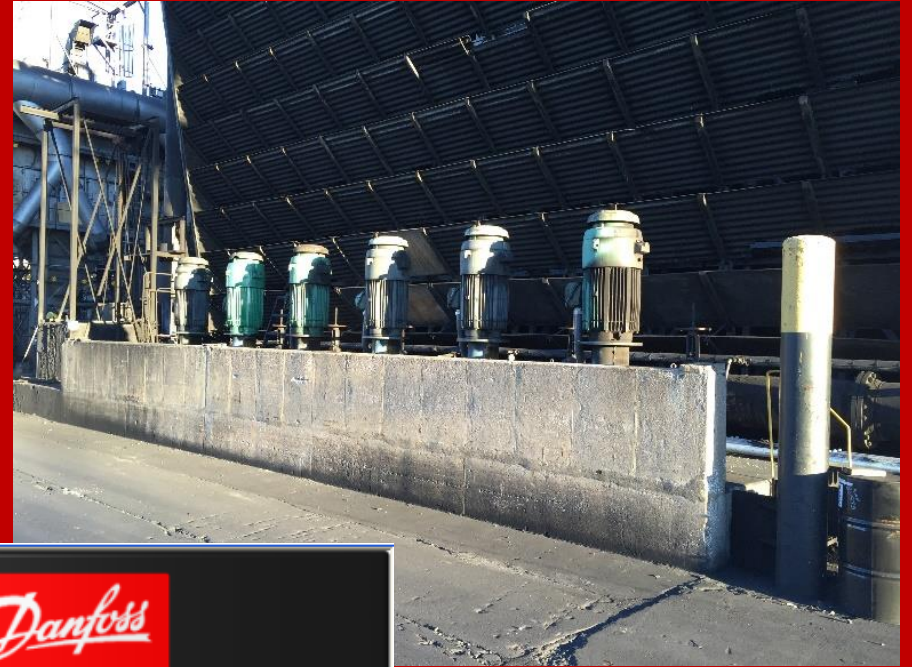


Limits on:

Current, Torque, Speed, Heat and Voltage

All help protect the VFD & the motor.

Detected a Short Without Incident



Condition Based Monitoring

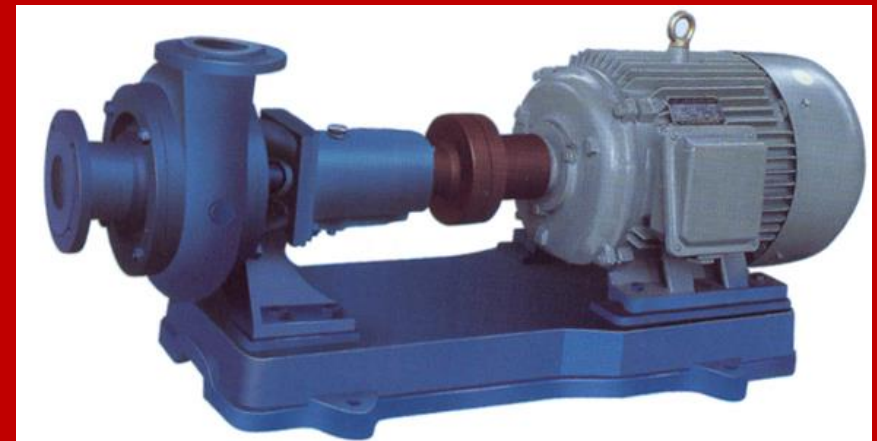


- Motor-Stator-Winding Monitoring:
- Vibration Monitoring in Application:
- Load Envelope:

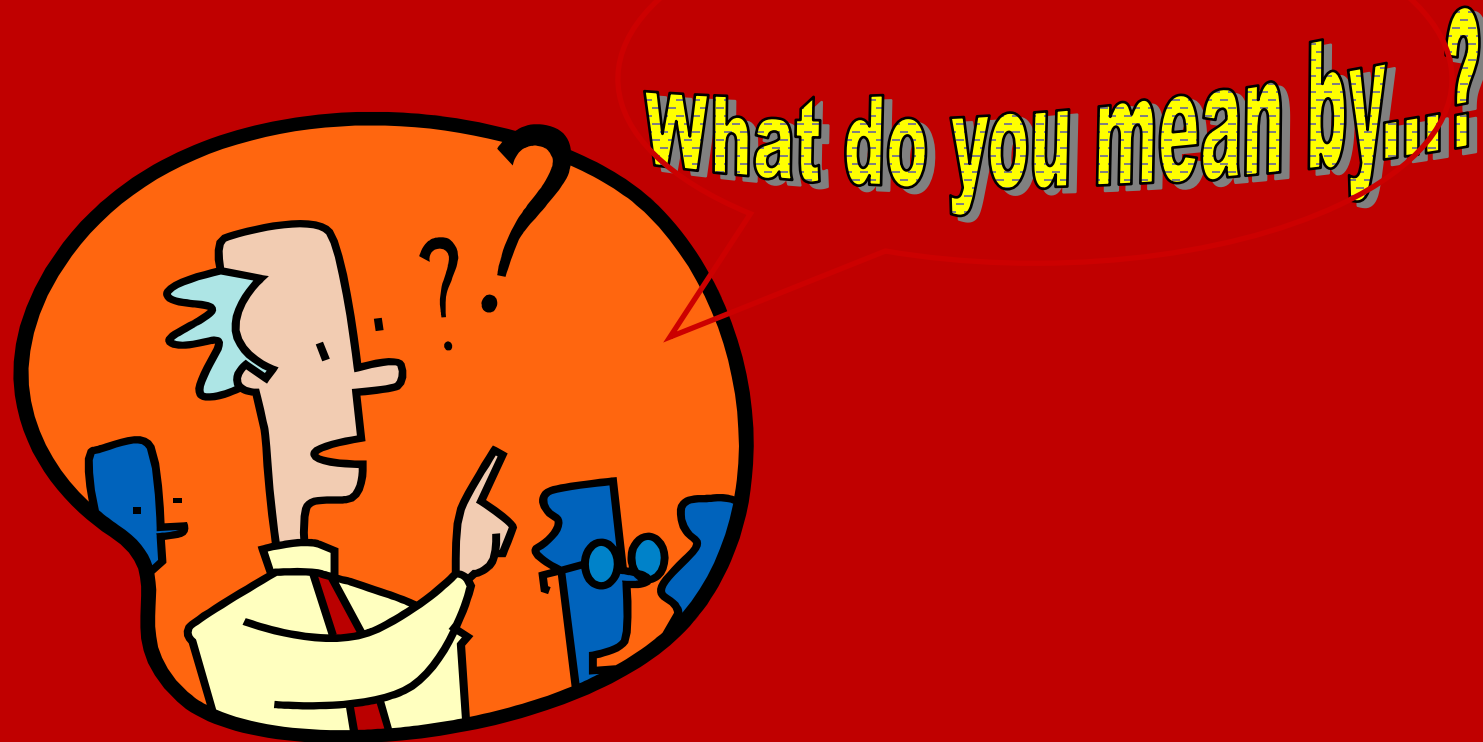
CBM Video: <https://www.youtube.com/watch?v=Y1x5AbqtPqE>

VFD's Help!

- 1. Reduce Energy Costs**
- 2. Better System Control**
- 3. Reduced Maintenance**
- 4. Bypass capabilities**
- 5. Protect the System**



Questions???



Danfoss Rockford Plant Tour:

<https://www.youtube.com/watch?v=A7MytVERSYE&t=6s>

Thank You