

Energy Savings & Innovations Forum

Perry Conte
Territory Manager

**Big (Energy) Savings = Free
Drives!!!!**



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Today's Topics

- Energy Savings = Free Drives
- What's a drive?
- Why use drives?
- Where are drives used?
- Saving energy by changing speeds
- Valves and dampers and vanes OH MY!!!
- Applications, applications, applications



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Free Drives ?!?

- The **INSTALLED** cost of Drives has been **FREE** in the past and will be again in the future.
- EX: Niagara Mohawk
Massachusetts Electric
California!!
- Why do Utilities do this?



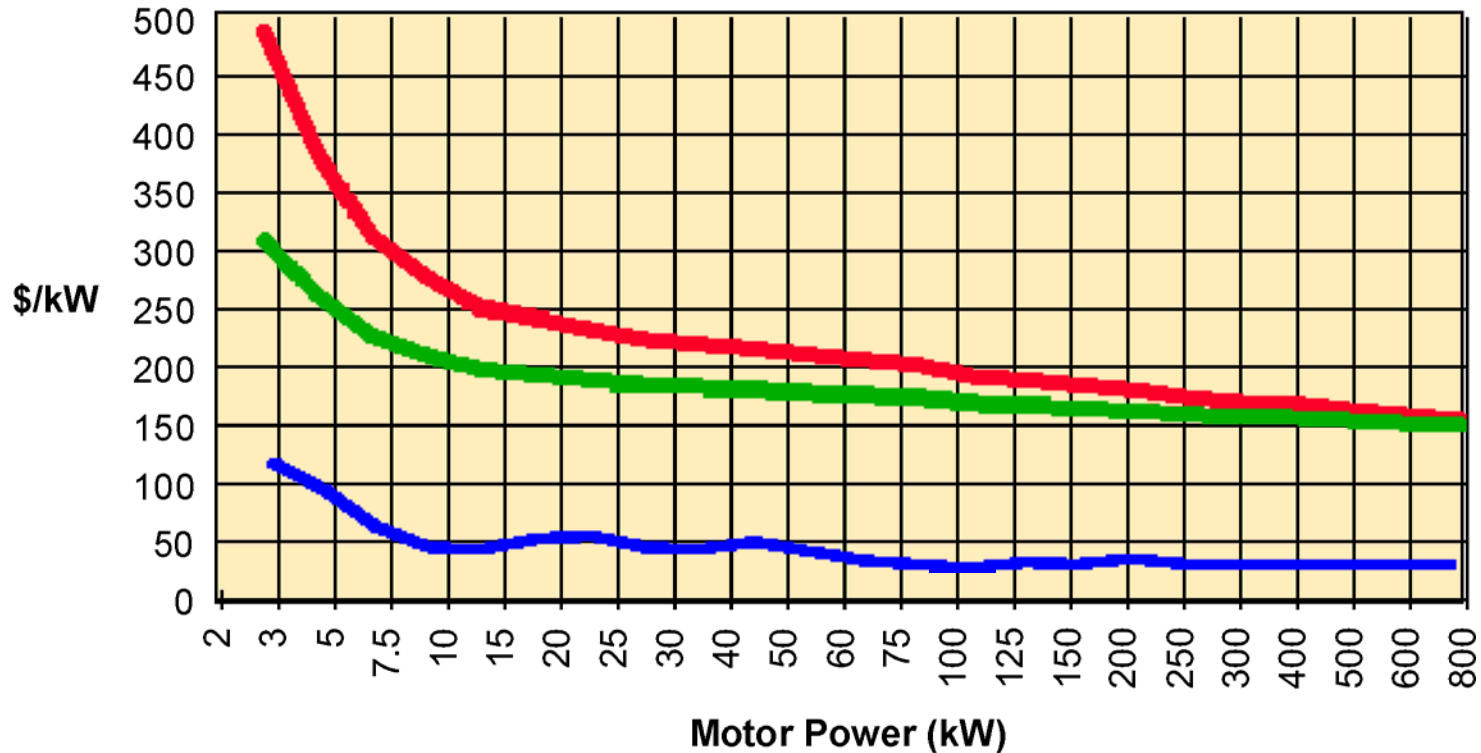
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Approximate Price Level of AC Drives

1992, 1995, 2008



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To generate or to save? ...That is the Question

- Total electrical energy is 100% of the total
- 63% of the electrical energy use is for motors¹ 63% of the total
- 60% of the motors are on pump and fans 38% of the total
- 50% of pumps and fans are potential for drives 19% of the total
- 50% of energy can be saved in these with drives 9.5% of the total

Drives can save 9.5% of Total Electrical Energy Use!!²

¹ Source: US Department of Energy

² Not counting 40% not on pump and fans



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What's a Drive?

- A drive is a power electronic device that takes AC line power and manipulates it to control the speed and/or torque of an AC or DC motor.
- When connected to a process control system, a drive is a semi-intelligent I/O.



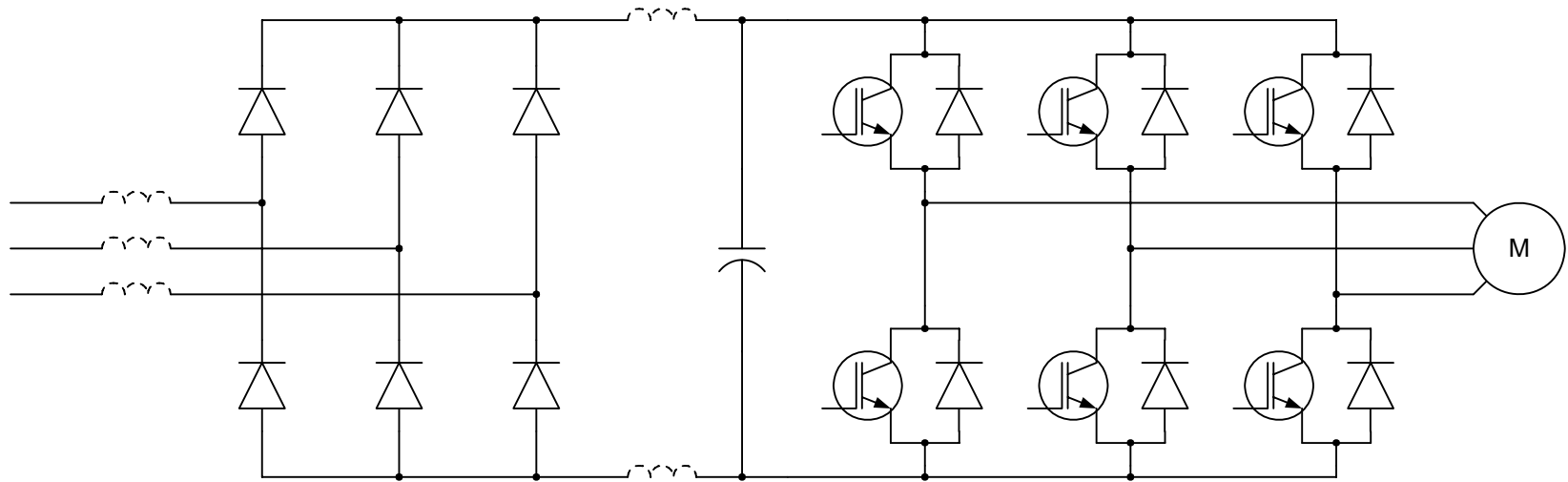
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What's a Drive?

Input
Converter
Diode Bridge
AC to DC



DC Bus
Filters and
smoothes
waveform

Inverter output-IGBT's
Switch DC Bus on and off at
different intervals



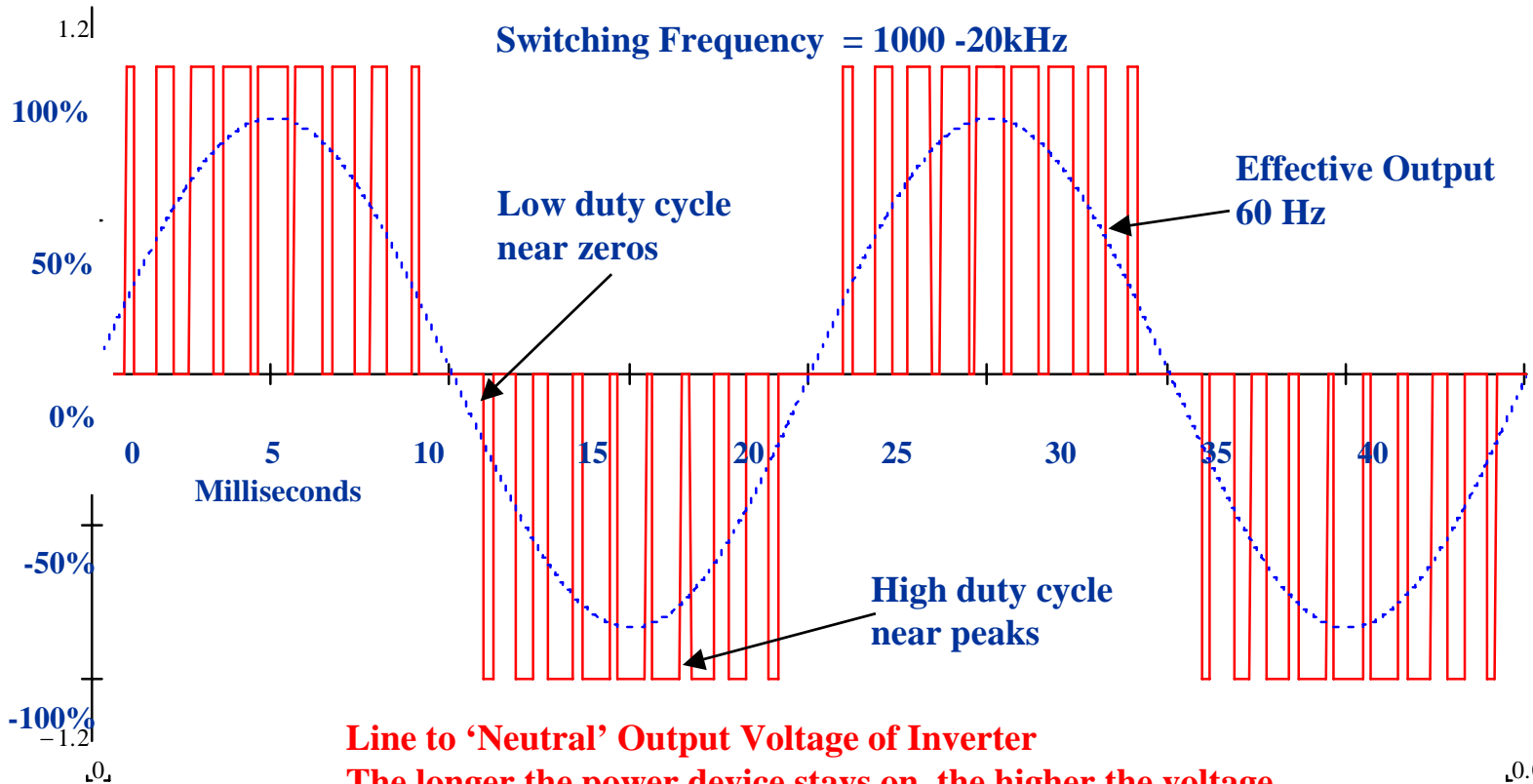
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PWM Drive, PWM Concept

AC Voltage and Frequency Control



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Why Are Drives Used?

- **ENERGY SAVINGS!!!**
- Soft start = less stress
- Longer mechanical life of motor and driven load
- Improved power factor (0.95 to 1.0)
- Coordination between motors
- Improved control of process
- Reduced demand charge (15 min. moving window)
- Easy interface ability with automation systems



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Why Are Drives Used?

- Improved speed regulation
 - From 3 to 5% for AC Motor across the line to - 0.3 to 0.01%
- Reduced maintenance relative to:
 - Other variable speed methods
 - Constant speed methods
- Ride-thru capability during power sags and outages (load inertia and drive type dependent)
 - Full output power at 80% line voltage possible!!!
- Electronic Reversing (= Contactor-less)
- Regeneration (like Hybrid Cars)



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Where are Drives used?

Two Types of Loads

- Constant Torque (Power varies **LINEARLY** with speed)
 - Examples:
 - Screw Type Air Compressors
 - Positive Displacement Pumps
 - Vacuum Pumps
 - Centrifuges



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Where are Drives used?

Two Types of Loads

- Variable Torque (Power varies with speed **CUBED**)
 - Examples:
 - Centrifugal Pumps
 - Centrifugal Fans
 - Cooling Tower Fans
 - Centrifugal Blowers
 - Centrifugal Compressors



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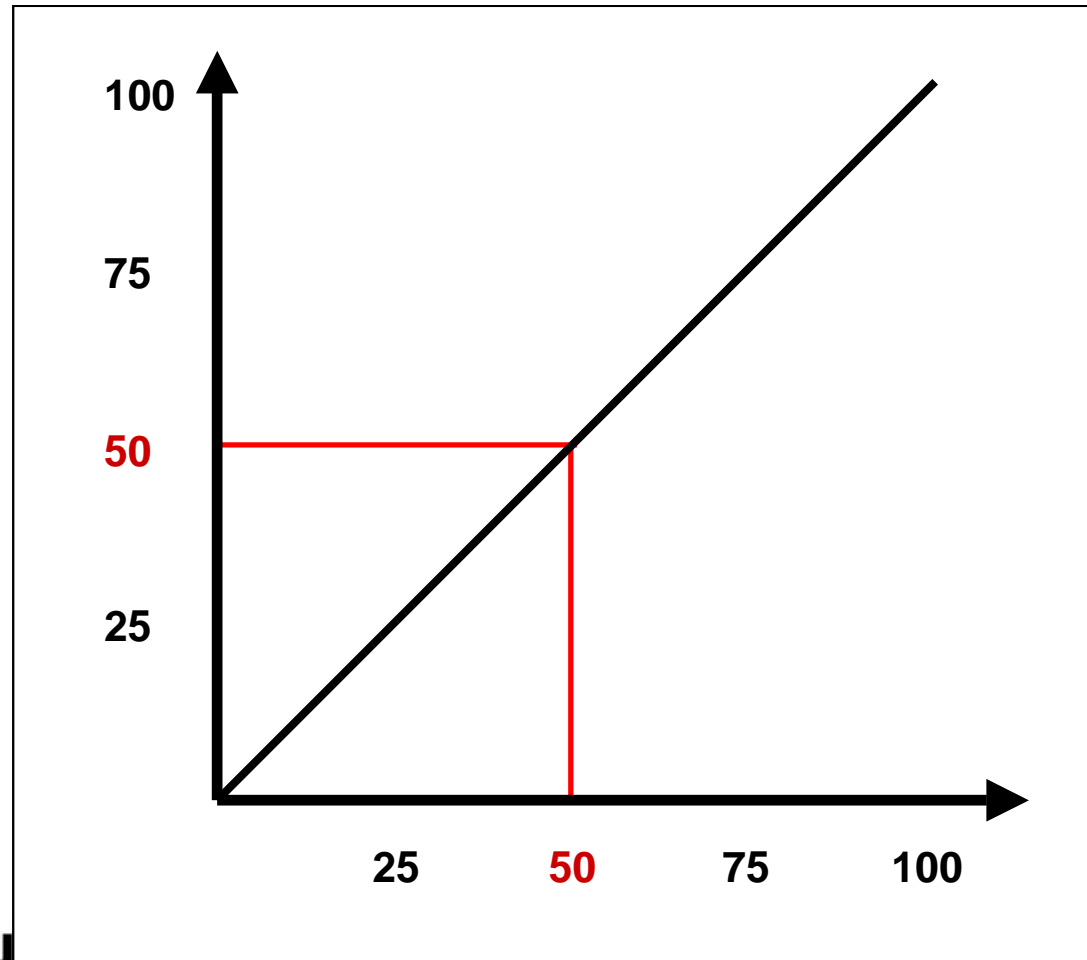
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Saving Energy by Changing Speeds

Power versus Speed - Constant Torque Load

Power is
proportional to
Speed



Speed (%RPM)

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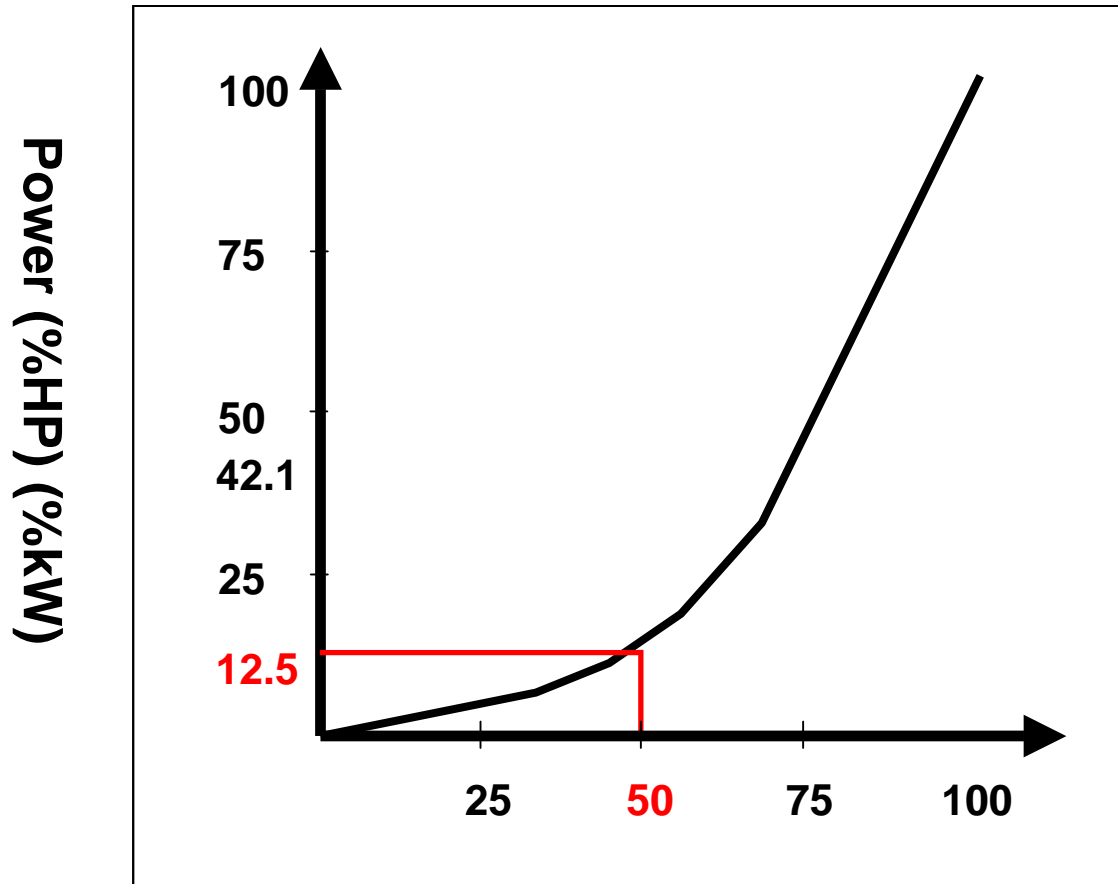


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Saving Energy by Changing Speeds

Power versus Speed - Variable Torque Load



Power is proportional to $(\text{Speed})^3$



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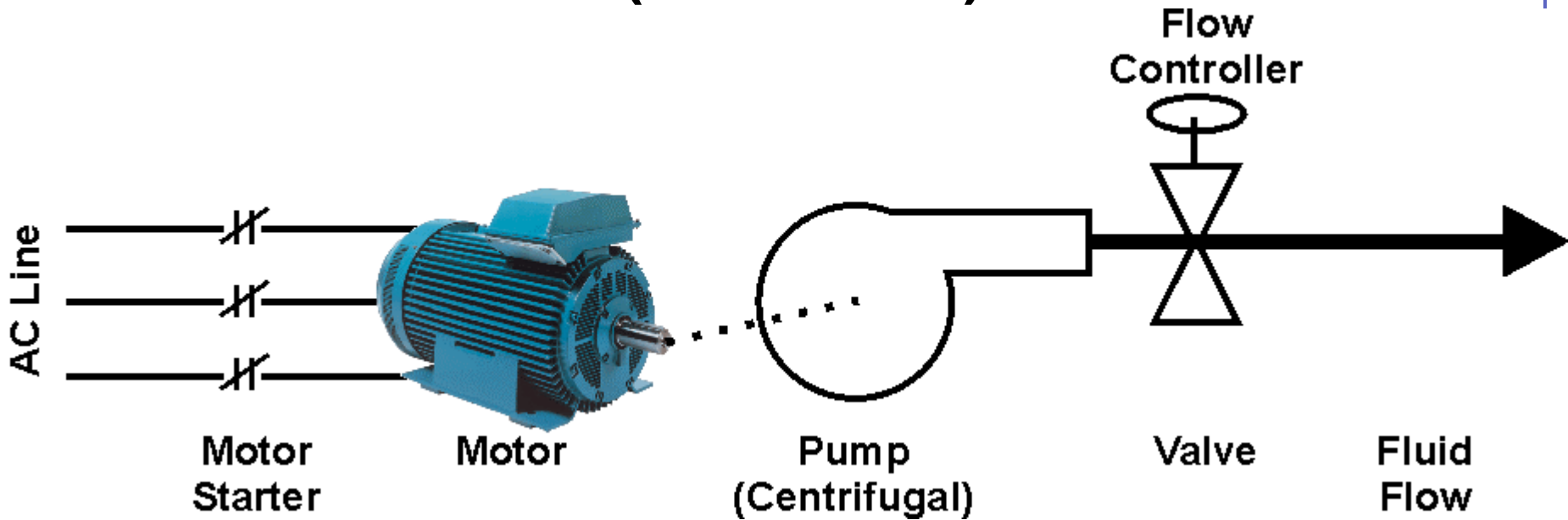
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Speed (%RPM), Flow (%GPM or %CFM)

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Valves and Dampers and Vanes... Oh My!!!

Fluid Flow Control of Pump (With Valve)



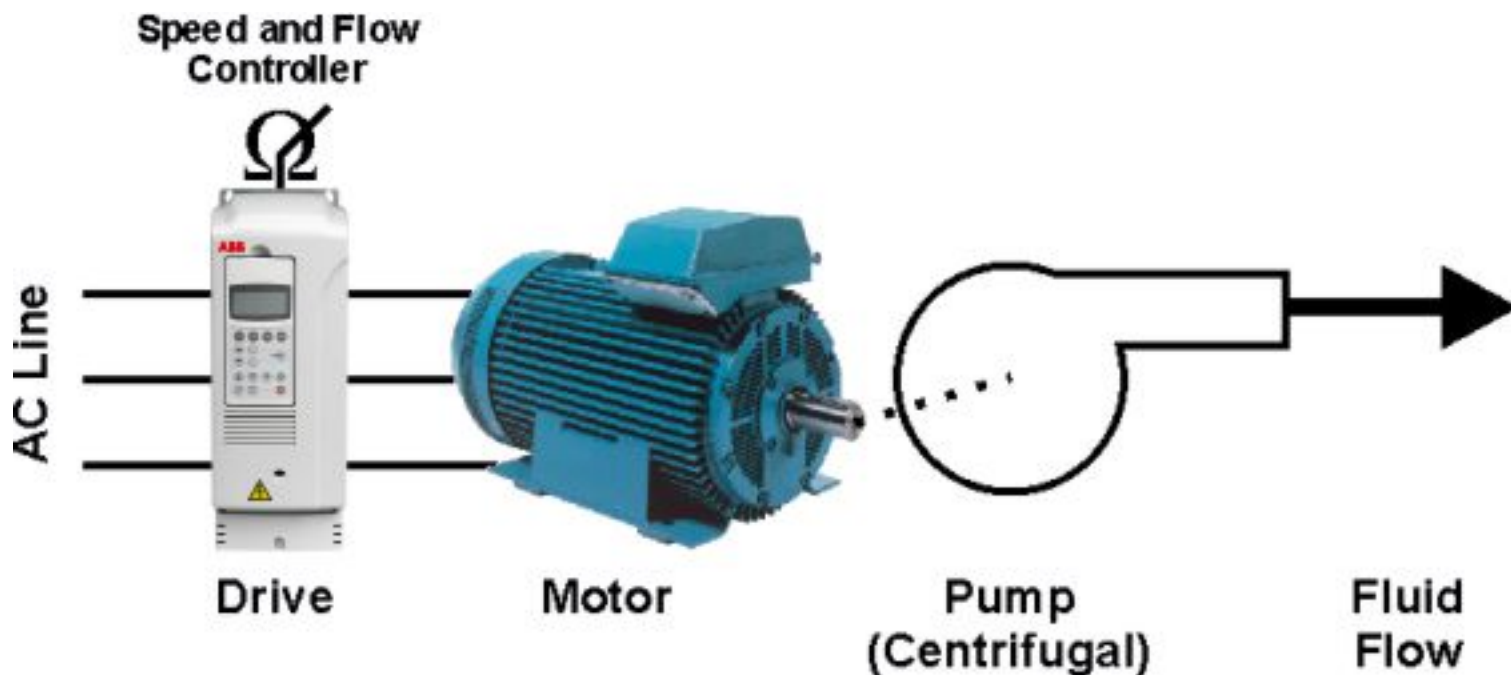
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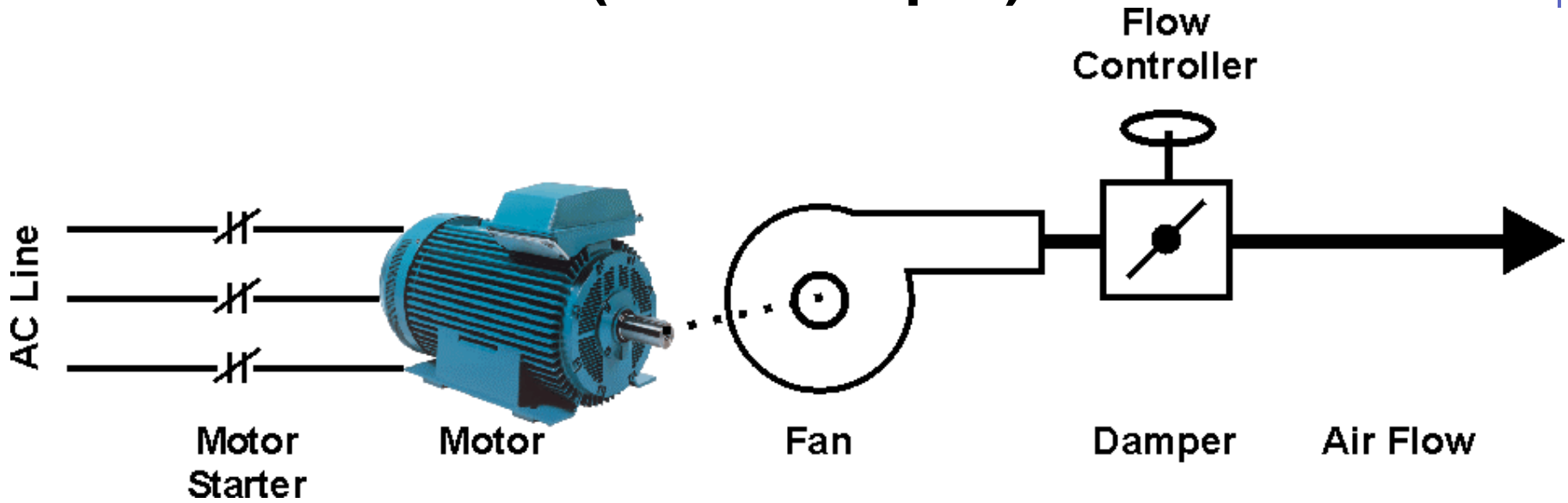
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Valves and Dampers and Vanes... Oh My!!!

Air Volume Flow Control of Fan (With Damper)



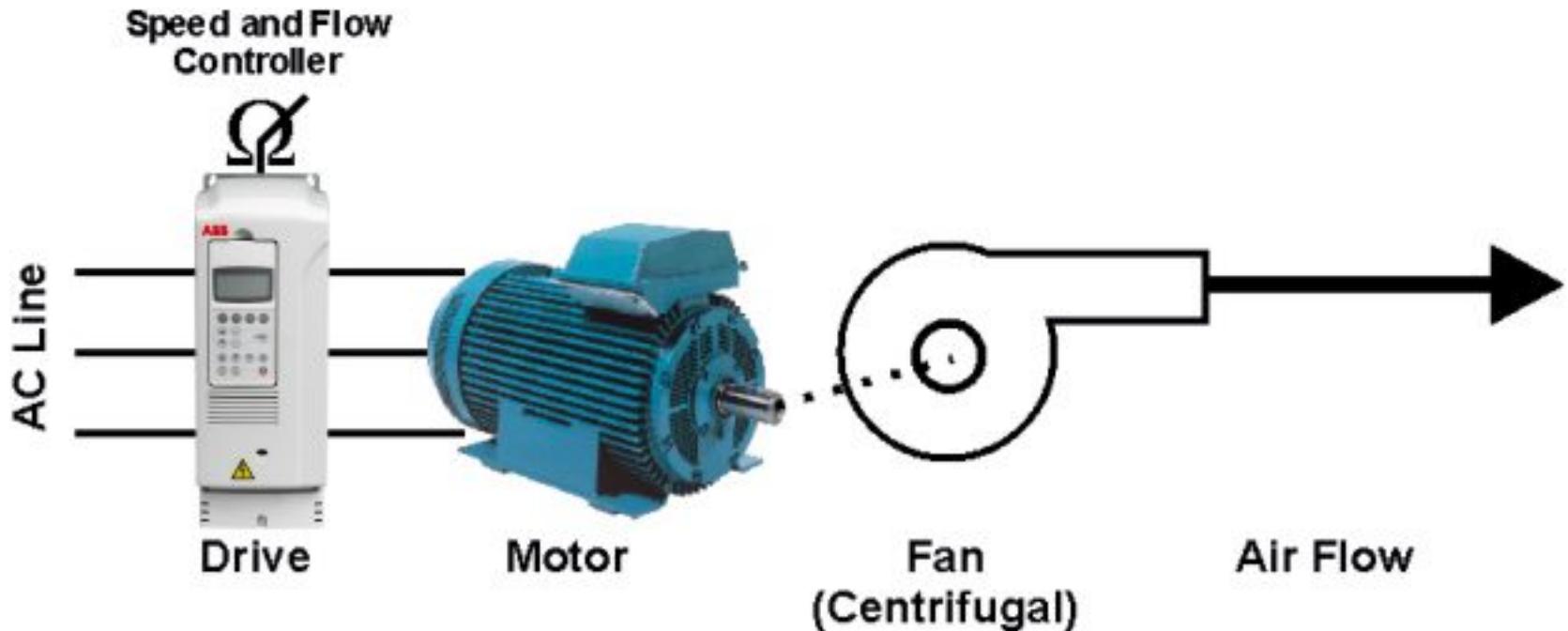
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Air Volume Flow Control of Fan (With Drive)



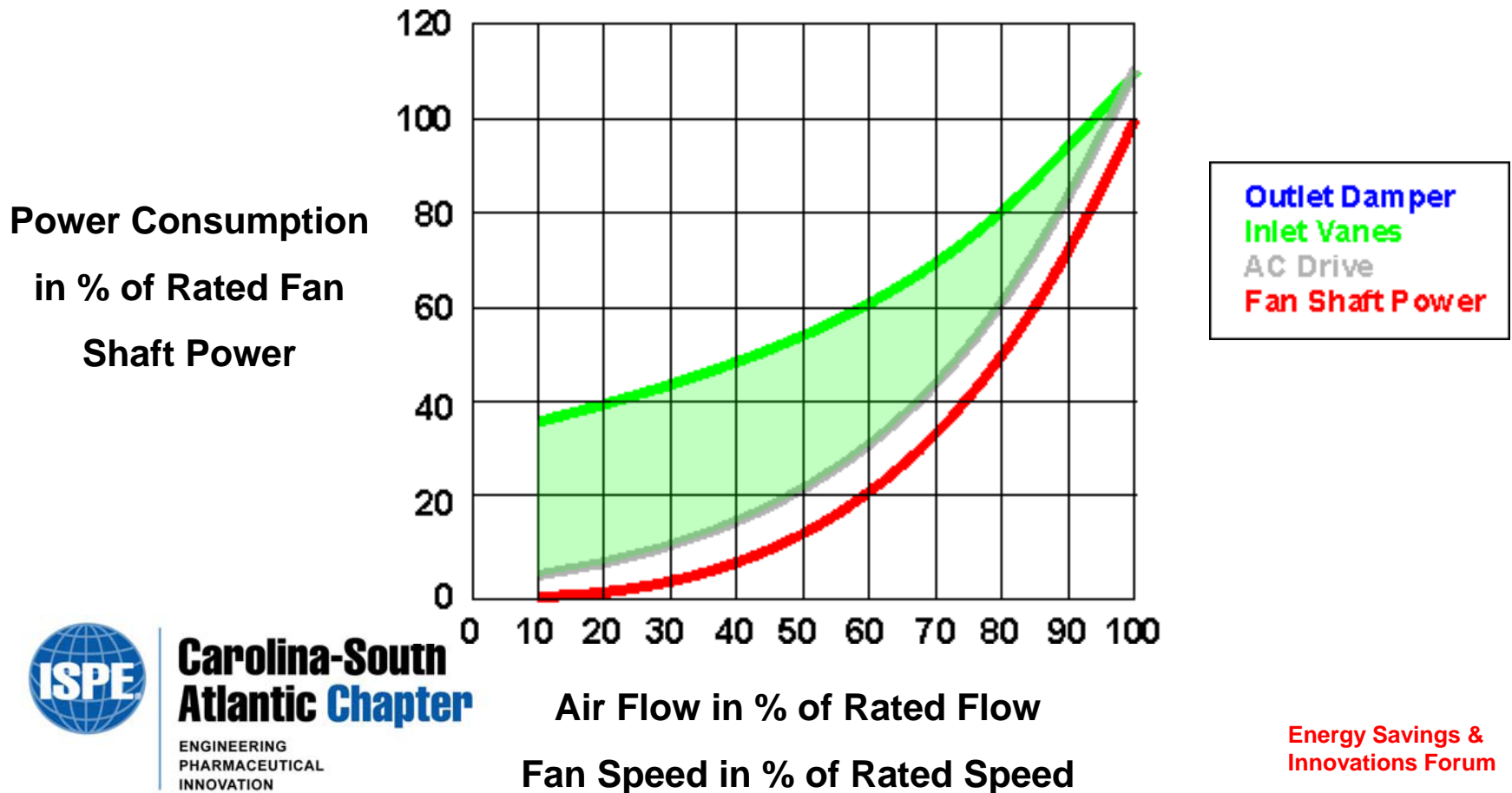
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Fan Power Consumption with Different Air Volume Control Methods



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Applications, Applications, Applications

- Conveyors
- Run-Out (Roller) Tables
- Kilns (Cement, Lime)
- Process Fans
- Boiler Fans
- Punch Presses
- Web Process Machines
- Plastic Injection Molding / Die Casting Machine Retrofits
- Extruders
- Centrifuges/Decanters/Separators
- Mixers / Blenders
- Process Pumps
- Cooling Tower Fans and Pumps
- Chiller Compressors



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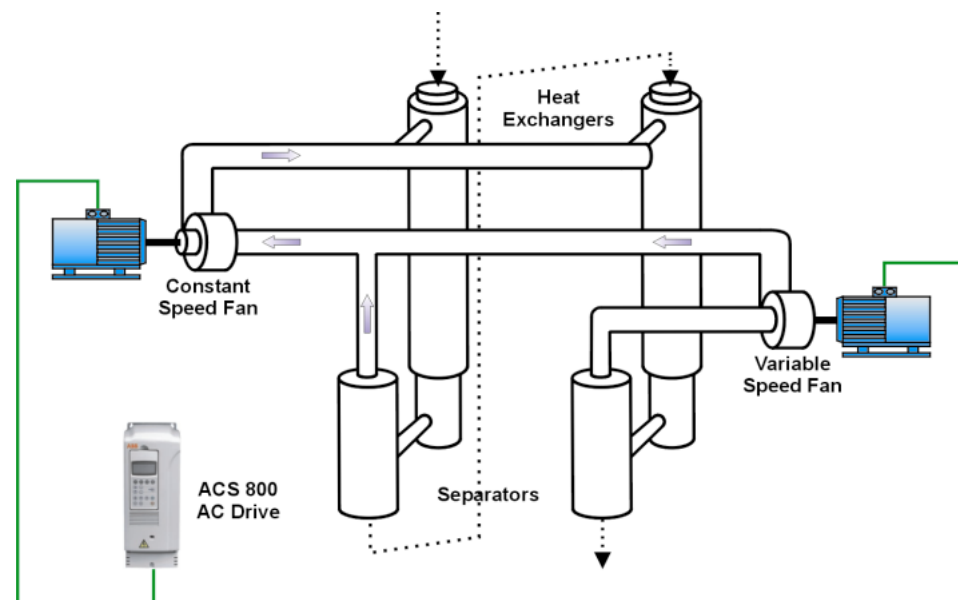
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Applications, Applications, Applications

■ Evaporator Fan

- Load Type: Variable Torque
- Reasons for Use:
 - Inlet guide vane retrofit = lower energy consumption
 - Dramatic energy savings during clean in place cycle
 - Flexibility in product processed
 - Production capacity adaptability
 - If heat exchanger efficiency changes, drive can compensate
 - Reduced motor size due to soft start
 - Soft start – reduced stress on fan blades
 - Low starting currents on weak electrical networks
 - High power factor – reduced power factor penalties



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Applications, Applications, Applications

■ Boiler Fans

- Load Type: Variable Torque
- Reasons for Use:
 - Energy savings \$15,000+/year at \$0.04/kWh
 - Dramatic boiler efficiency increases with some schemes
 - Fast response to system changes to maintain pressure
 - Higher efficiency than inlet vanes, dampers, or fluid couplings = reduced energy consumption
 - Decreased maintenance
 - Ability to 'meter' air to fuel
 - Dramatic reduction in NOX emissions
 - Ability to run boiler at very low turn downs = reduced time to get cold boiler producing steam
 - Increased fan reliability due to critical frequency avoidance



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Applications, Applications, Applications

Power Plant Scrubber Booster Fan

(See top of Page 43 in 100 Top Energy Saving AC Drive Tips)



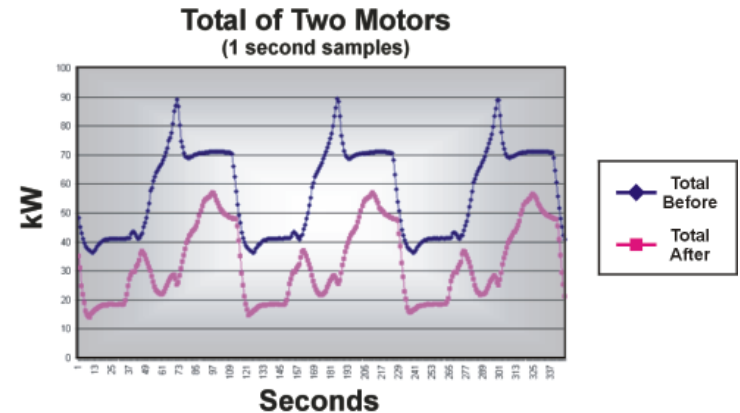
- University of Illinois in Champaign, IL
- Energy Savings approximately 1,460,000 KWh/year
- Replaced Inlet Guide Vanes
- Used 1,000 HP Medium Voltage (4160VAC) AC Drive = ACS 1000



Applications, Applications, Applications

■ Plastic Injection Molding / Die Casting Machines

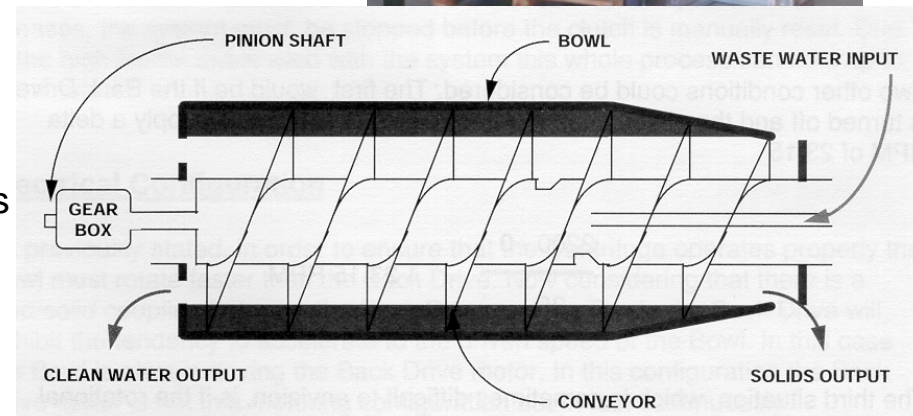
- Load Type: Constant Torque
- Reasons for Use:
 - Reduced Energy Savings
 - 40 to 60% on some machines
 - Reduced temperature of hydraulic fluid, machine and work environment
 - Consistent hydraulic flow control without fluid recycling
 - Less hydraulic fluid leakage
 - Quick and easy setup changes by existing plant personnel
 - Improved power factor – reduced power factor penalties or mitigation equipment



Applications, Applications, Applications

■ Centrifuges (Batch and Continuous)

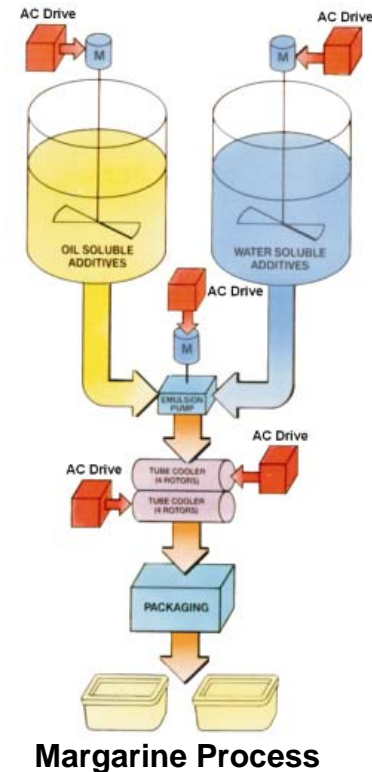
- Load Type: Constant Torque
- Reasons for Use:
 - Reduced energy consumption via multiple schemes to 'reuse' regenerated energy
 - Excellent ability to control torque and speed to control large inertias
 - Eliminates need for mechanical torque overload clutch
 - Increased up time – no 30 minutes to reset torque overload clutch
 - Excellent torque control accuracy over very wide speed range
 - Tripless operation
 - Encoderless operation
 - High reliability/ MTBF=150,000+ hours
 - Consistent moisture content of centrifuge output
 - Dramatic increase in throughput/productivity



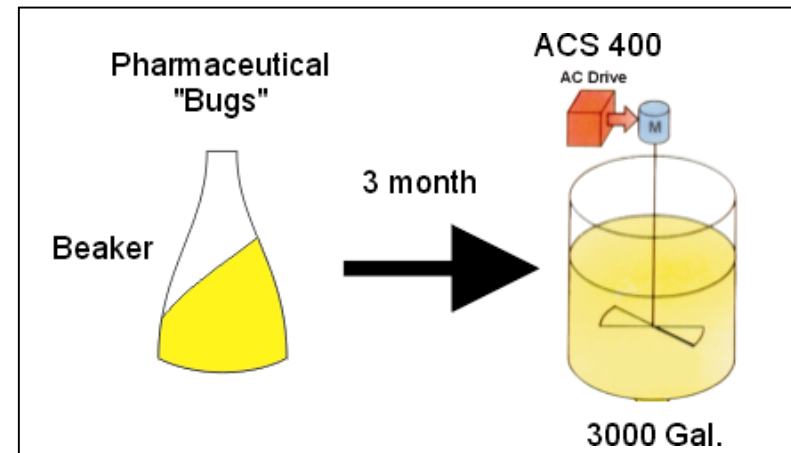
Applications, Applications, Applications

■ Mixers/Blenders

- Load Type: Between Constant Torque and Variable Torque
- Reasons for Use:
 - Ability to accurately control speed, torque and power put into the mixing/blending process
 - High reliability (20 minutes down time = "bugs" die)
 - Ability to measure power put into process
 - Torque & Viscosity = Ability to use drive as viscosity meter
 - Soft start function = reduced stress on driven equipment and PT components
 - Compatible with explosion proof AC motors
 - High starting torque
 - Easily operated by plant personnel
 - Easily interfaced to process controllers
 - Reduced maintenance relative to other variable speed methods



Margarine Process



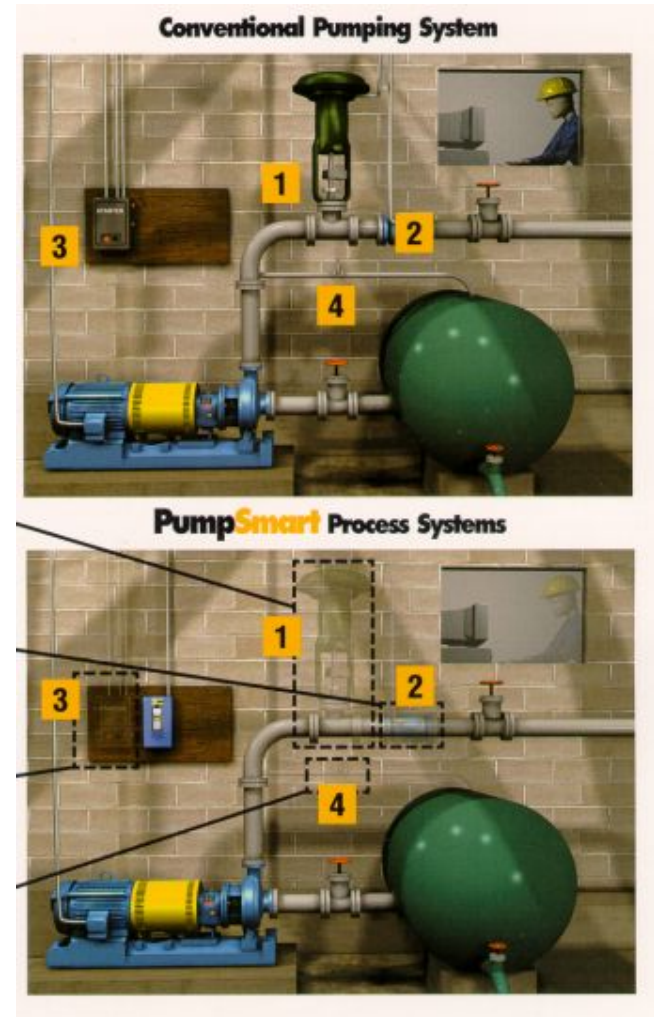
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Applications, Applications, Applications

■ Process Pumps

- Load Type:
 - Centrifugal = Variable Torque
- Reasons for Use:
 - Reduced Life Cycle Costs (100HP; 15yrs)
 - Initial Costs (\$800)
 - Installation Costs (\$29,250)
 - Maintenance Costs (\$16,123)
 - Operating Costs (\$229,273 @ \$0.06/kW)
 - Significantly increased MTBF
 - Protects pumps from:
 - Cavitating
 - Running dry
 - Running with suction or discharge valves closed
 - Possible to Eliminate:
 - Flow control valves 1
 - Flow meters 2



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Starters 3
More effective process control
Visit www.gouldspump.com

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Applications, Applications, Applications

■ Cooling Tower Fans

- Type of Load: Variable Torque
- Reasons for Use:
 - 25% of 3.75 MW = result of fan power savings at reduced speed
 - Soft start function saves 0.6 MW by using the VFDs to ramp up all 69 21' and 33' diameter fans at equal speeds
 - Made development of back pressure optimizer possible
 - Net output of plant increased 28 MW during high ambient temperatures
 - Ability to overspeed fans
 - Eliminated Rime ice and need to control manually during sub-freezing temperatures



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Applications, Applications, Applications

■ Centrifugal Chillers

- Load Type: Variable Torque
- Reasons to Use:
 - Lower energy costs
 - Reduced peak demand charges
 - Soft start of compressor motor = longer life
 - Reduced chiller maintenance
 - Tighter chilled water temperature control = $\pm 0.1^{\circ}\text{F}$
 - Power outage protection
 - Real time surge protection
 - Eliminates need for hot gas bypass
 - Eliminates need for power factor capacitors



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Applications, Applications, Applications

Water Pumps at Southern California Oil Field

- Quantity 3 125HP Centrifugal Pumps
- Average Utility Power Cost = \$0.11 per KWh
- Run Continuously (8760 hours per year)
- Energy Savings = 284,000 KWh/year
= \$31,354/year
- Conservative Installed Drive Price = \$20,000
- Payback = 8 Months!!! = **Free Drive!!!**



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What We Have to Help You Save Energy with Drives?

- **Energy Savings CD**
- **“Try it, You’ll Like it” Units**
 - **60 Hz for a month**
 - **Modulate for a month**
 - **KWh “meter” internal to the drive**



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