Techsys Corporation

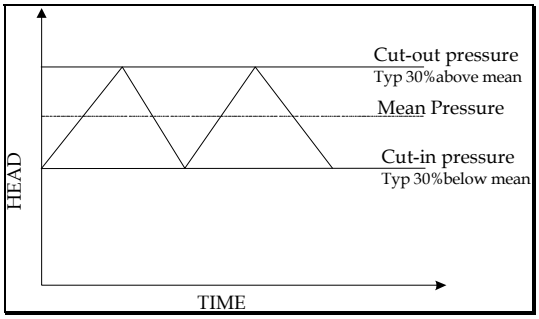
APPLICATIONS BULLETIN

PRESSURE SYSTEM Vs VARIABLE SPEED DRIVE SYSTEM

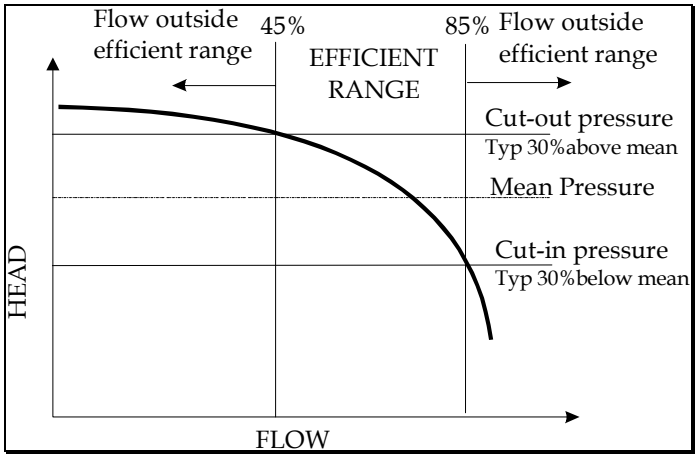
There are many times when we are asked why should we use a VFD pumping system in lieu of a standard pressure system and this Applications Bulletin will address the major points of the arguments.

PRESSURE SYSTEM

The pressure system utilizing multiple pumps has been the main source of pressurized water supply for numerous applications for many years. It works on the principle of low pressure cut-in and high pressure cut-out settings to maintain a pressure band between these two pressure settings.



To operate satisfactorily the Cut-in and Cut-out setting must be spanned sufficiently to reduce rapid stopping and starting (commonly called Hunting) when flows below the pump capacity occur. With a centrifugal style pump the typical pressure ranges that dictate satisfactory operation occur at ⌖30% of mean pressure and normally between 45-85% of nominal maximum flowrate. This leaves a large range of operation where the pump must rely on non efficient pumping or hunt between the cut in and cut out pressures.

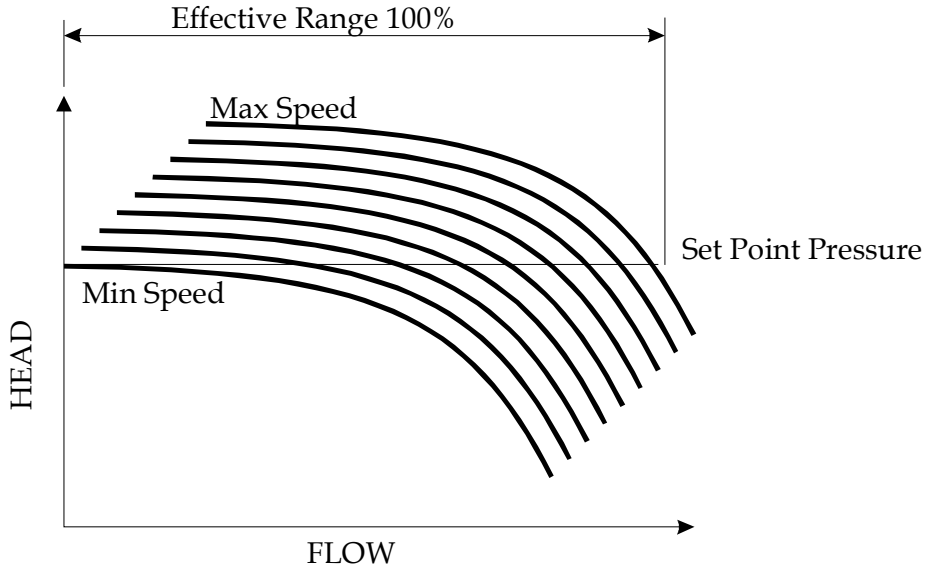


The short fall in operating flow range is made up by using a pneumatic accumulator (pressure tank) to provide small amounts of flow to satisfy the minimum pumping requirement. These tanks can vary in size from 300mm dia. and 400mm high to 2 m dia and 3m high depending upon the flow/ pressure characteristics of the pump and system.

The whole system relies on the selected pump having a relatively steep stable pump curve. If the curve is not steep and stable then the system cannot be run on pressure and requires a flow device for stopping and pressure for starting. This can lead to complications and poor reliability.

VFD SYSTEM

The VFD pumping system utilizes a Variable Speed Drive to vary the pump speed to maintain a constant pressure irrespective of the flow demand in the system. It will always work from zero flow to maximum capacity of the pump at the desired set point.



The steepness or stability of the curve is not an issue as the control system allows for the change in flow to stabilize any variations in curve stability.
The properties of pump are defined in the Affinity Laws by the following formula:

$$\frac{S_1}{S_2} = \frac{H^2_1}{H^2_2}$$

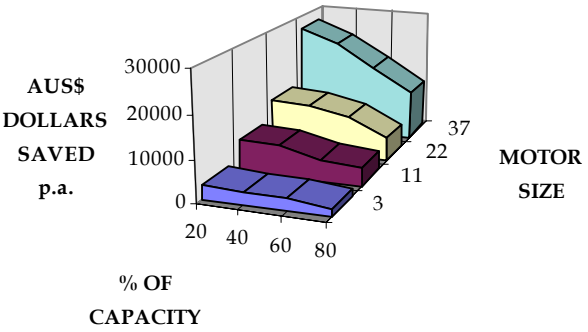
$$\frac{S_1}{S_2} = \frac{P^3_1}{P^3_2}$$

This shows that the power usage is proportional to the cubic factor of the speed of the pump. i.e. 1/2 the speed then 1/8 of the power will be used. This is the theory behind the major economical advantage of the Variable speed system over the pressure system.

COMPARISONS

RUNNING COSTS

A typical example of a VFD System compared to a pressure system will show that the running cost analysis will vary with the flow rate being used. The graph below shows the comparison of a VFD system to a single fixed speed pump. This is shown to compare the fixed speed solution to both the VFD and pressure pump solution as the worst case for running cost..



The cost comparison of a pressure system and a VFD system is best shown by example where the flow rate is below the nominal cut in pressure flow, as this shows the start stop effect on the pressure system .

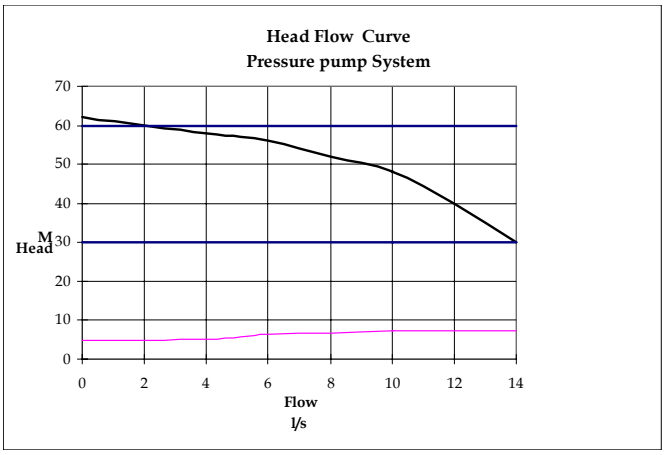
EXAMPLE
A pressure requirement of 50m Head and a flow of 9 l/s

The assumptions made are:

- Pressure system has a 20 lt. draw-off tank
- The pump used is a Southern Cross SV40-04
- The duty flow rate is 9 l/s Vs 50 m head.

Show running cost for all flows for both units for direct comparison

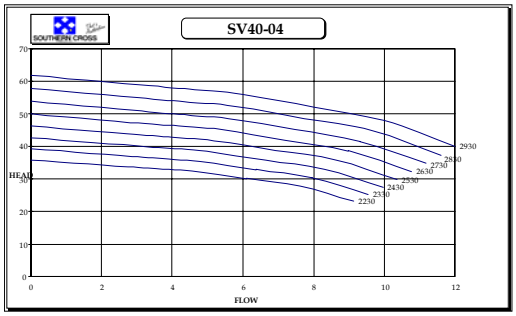
PRESSURE SYSTEM DATA



Flow	Cycle Time	Energy used	Energy Cost
l/s	sec	kWhr	$A
0	8.0	16.1	$0.00
1	9.2	15.0	$2.99
6	40.0	8.5	$1.70
8	No Cycle	6.8	$1.36
10	No Cycle	7.2	$1.44
12	No Cycle	7.2	$1.44
14	No Cycle	7.4	$1.48

Cut in pressure- 300 kPa
Cut out pressure- 600kPa

VFD SYSTEM



Flow	Energy used	Energy Cost
l/s	kWhr	$A
4	4.20	$0.84
6	5.60	$1.12
8	6.10	$1.22
9	7.00	$1.40

ENERGY COMPARISON

The pressure system will use considerably more power when the system has a wide variety of flow rates. The closer the system flow gets to the maximum duty the closer the running costs become. The main energy draw from a constantly cycling pressure system comes from the constant DOL. current draw that is developed on startup.

OTHER CONSIDERATIONS

Constant pressure

The VFD system will give a constant pressure ⌖ 3% The pressure system has a range of ⌖ 25-30% depending upon the pump type. This can effect processes, service and can be a major cost in repairs and maintenance.

Water Hammer

The VFD system is designed to minimize water hammer and operate within very tight pressure spike specifications. The Pressure system can create up to 18 times the pump shut off head by causing pressure harmonics and pressure surges.

Floor space.

As the VFD system uses control to speed up and switch pumps there is generally no need for a pressure tank.
The pressure system on the other hand must have a pressure tank which is generally quite large with associated plumbing. The space saving for a VFD system over a pressure system is generally 2-3 times

Pump Protection

The VFD system has built in protection to compare feedback with set parameters to always keep the system operative. The pressure system requires these as an option.

Multiple pump capacity.

For the pressure system the span of the Cut-in and Cut-out pressures are critical . The number of pumps available to be used is very limited. Generally any number over 2 pumps will require tuning by technicians to balance the system with the pump capacities.
The VFD System control is able to accommodate multiple pumps covering a wider effective flow range at a precise pressure. Ultimate 1 can control at least 4 pumps in all ranges of flow.

Capital Cost

The only difference between the VFD and the Pressure system is the cost of the inverters. These are now at a cost to allow for running cost savings to pay for the capital difference within 6 to 12 months.