CAN A VFD AND CONSTANT PRESSURE PUMP CONTROL VALVE WORK TOGETHER?

Cary Austin, Cycle Stop Valves

Historically, pump control relied on using a large pressure tank or water tower and cycling the pump on and off as needed. The ability to vary the flow rate of a pump to match the demands revolutionized the industry. Over the years automatic transmissions, eddy current clutches, and many other devices were tried. Pump control valves have been the mainstay of varying pump flow and maintaining pressure for generations.

However, in the last few decades, Variable Frequency Drives or VFD's have become common place. This is largely due to the common misconception that VFD's save energy. Although the amps are reduced as the speed is reduced, the flow rate drops off at a much steeper rate. This makes it hundreds of percent less efficient to vary the pump speed as opposed to operating at full speed and the pumps Best Efficiency Point or BEP. As a matter of fact, there is very little difference between the drop in amperage between a pump being controlled by a VFD or a simple, mechanical, reliable pump control valve.

Varying the pump speed or frequency to maintain a constant pressure can be a good way to control a water system. A VFD can have many benefits including a soft start, the ability to convert single phase to three phase, built in protections, and even the ability to monitor and control the pump from your phone.

However, there are a few inherent problems with varying a pumps speed or frequency. Head is lost by the square of the pump speed so when maintaining a constant pressure, very little reduction in speed is possible. Motors are less efficient at reduced speeds.

Other problems include: Resonance frequency vibration as all pumps have multiple critical speeds to avoid; reaction speed is programmed and can't always react as fast as changes in the flow rate can happen; harmonics, voltage spikes, resonate frequencies, etc. Just being able to figure the minimum frequency that will keep the pump from cycling at low flow rates yet still go to sleep when needed can be a problem.

A constant pressure pump control valve working in conjunction with a VFD on a irrigation system.

Many of these problems are remedied by adding pressure tanks, filters in the electronics, and by incorporating "bump" or "boost" modes to the programming. Over the years, when any of these remedies were not satisfactory a Constant Pressure Pump Control Valve or CPPCV working in conjunction with the VFD was the answer.

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By setting the set point of the VFD a few PSI higher than the set point of the CPPCV, a VFD and CPPCV can work together. In this way the pump runs at full speed and the CPPCV controls the flow and pressure. The VFD still delivers built in protections, electronic soft start, sleep mode, as well as the ability to monitor and control the pump from your phone.

With the pump at full speed and the CPPCV controlling the flow and pressure, the energy use is basically the same. However, there are no more critical speeds to avoid, resonance vibrations, slow reaction speeds, or the need to figure minimum frequency for every application.

The CPPCV just cannot close to less than 1 or 5 GPM, depending on valve size, which is enough to cool the pump and motor. As long as the minimum flow rate being used is more than 1 or 5 GPM, the CPPCV maintains constant pressure while the pump runs smoothly at full speed with reduced amperage. When demand is less than 1 or 5 GPM, the water bypassing in the CPPCV increases pressure to the VFD set point. The VFD then ramps down the pump to the set point of the VFD, and the pump goes to sleep.

For the following example, we will use a 25 GPM well pump with a CPPCV utilizes a 1 GPM minimum.

With the CPPCV set at 50 PSI the system will stay at 50 and never get to the 60 PSI set point of the VFD as long as demand is more than 1 GPM. When demand is less than 1 GPM or zero, the 1 GPM bypassing through the CPPCV fills the system and pressure tank to 60 PSI where the VFD reduces to the minimum hertz setting and then goes to sleep. The CPPCV eliminates all the many issues created by varying the pump speed, and the system still has the benefits of the soft start, monitoring, and control that a VFD can provide.

We know the amp drop of a centrifugal pump is about the same when restricting the flow with a valve as when reducing the pump speed with a VFD so the actual flow rate being used is what actually determines efficiency. Designing systems to work close to the BEP of the pump the majority of the time is the most efficient way of pumping water. Smaller flow rates will always be less efficient with VFD's or pump control valves, so they should be limited as much as possible.

Most VFD or CPPCV irrigation systems only start once per day as the irrigation session begins.

With a variety of sizes and flow rates a CPPCV can be used in all typed of applications from home use to municipal water usage.

This makes soft starts much less important than when cycling 50 to 300 times a day was the primary form of pump control.

However, some utilities still require a soft start on motors larger than 5 HP. Starting a pump against an almost closed valve, as with a CPPCV, gives a mechanical soft start. The CPPCV greatly reduces the duration while the VFD reduces the amplitude, making the softest start possible for the distribution system as well as the electric grid.

Although CPPCV's and VFD's both deliver constant pressure and variable flow rates when utilized alone, using them in conjunction can also have many benefits in some applications.

For more information on constant pressure pump control valves - Log onto cyclestopvalves.com.

Cary Austin has a master water well driller/pump installer license and 54 years experience. He also holds 5 US patents for Cycle Stop Valves®. To contact email at caustin@cyclestopvalves.com or call (806)885-4445.