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Ergs, Joules & Such

Notes On Energy Savings for the Rural Water Community and Maybe Others

In the November issue of *The Kansas Lifeline*, I provided a quick review of Variable Frequency Drives (VFDs) and I indicated that in a future issue, I would look at a painless way to obtain one for your city or RWD. Well, here we go.

I'm going to us a hypothetical system; hopefully I have chosen one that is representative. The "E, J & S Water Authority" has 500 meters; it operates one well with a 100 horsepower pump and motor that produces 300 gpm. (I've assumed that the engineer expected significant growth and over-designed this supply). What can we expect to see in possible savings by installing a VFD?

- First, let's assume these customers use the average of about 6,000 gallons/meter/month or 3,000,000 gallons total. Further, let's assume the system has a twenty percent water loss so the well has to produce about 3.75 million gallons per month.
- Doing the math, I determine that the well pump motor only has to operate a little over 6.9 hours per day to meet this production or, approximately 208 hours in a thirty-day month. As I say, this facility is over-sized, which makes it a prime candidate for a VFD.
- I won't belabor readers with all the math here, but let's assume this 100 hp motor has a demand of about 80 kW. We can calculate that the electric power bill for this operation (in Alabama where I'm more familiar with electric rates) would be about **$2000/month** exclusive of taxes and minor bill adjustments. Alabama rates are a little below the average, so the same operation in other states could easily cost more.
- Okay, given that setup, what can a VFD do for our hypothetical system? Well, first it's going to cost some bucks – probably $100 per horsepower, or more. Let's be real conservative and say $15,000 for an installed controller. Could it possibly pay for itself?
- Here's the huge advantage of VFDs – **they reduce electric demand by as much as the cube of the fraction that the speed (output) is lowered to.** In our example system, if we can stand for the pump to operate about half-time (twelve hours/day instead of seven hours/day), the theoretical demand reduction is $(7/12)^3$ or about twenty percent of the original 80 kW. But let's be generous and say it only reduces demand to fifty percent or 40 kW. What do the savings look like?
- Again, without boring readers with the math, the new estimated bill at 40 kW and twelve hours/day run time would be about $1,500/month. That's a savings of **$500/month!**
- Fortunately, that's not all the good news. With the **NRWA Small System Revolving Loan Fund**, small water systems can currently borrow seventy-five percent of the $15,000 at three percent interest. For a five-year loan, this results in a monthly payment of only about $202; if the loan had a ten-year maturity, the payment would be only $108/month. Even if the system borrowed the balance ($3,750) at bank rates, **it looks to me like a system could net up to $200 or more a month on this deal!**
- Also, remember these controllers also provide "soft starts". If power factor is a problem for a utility, the VFD may solve that too.

If I were a water system manager, I would add a couple of things to my tool chest – **VFDs and NRWA Revolving Loan Fund. Contact the Kansas Rural Water Association for more information.**

When using VFDs in water pumping, the actual energy savings may be significantly less than theoretical. The reason has to do with most water pumping being done against both static and dynamic heads, plus the influence of pump curve efficiency changes with changes in pump speed. The bottom line is that energy savings can still be substantial but it is essential that you have a pump/VFD specialist evaluate your specific situation before making commitments. And don't forget, other applications such as blower motor control may not have this problem.

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