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THE LONGO LETTER

April 1999

CURRENT EVENTS
by
Joseph J. Longo
President

Energy Savings & Safety, Too!
. . . from line-to-load

Saving money on electric power usage has become routine. As the famous Jimmy Durante used to say, "Everybody wants to get into the act!" It's interesting to recall that in 1973, when the fuel embargo was in effect, you couldn't give away energy efficient motors. Even though, we at that time, as we can today, clearly demonstrate that spending $1000 to replace perfectly good units with energy efficient ones, get your $5000 back the same day. If you think that's impossible, have us do a payback analysis for you. Ask your Longo salesperson about it!

As time moves on, other issues catch our attention, including other items in a power train. This relates to the efficiency of a connected gearbox, pump, fan, etc. In this issue, we address the combined efficiency of drive *systems* which equals the product of the successive devices, i.e., they get multiplied. Given that efficiencies are always less than one (1.00), you can more likely relate to it (more inside). You really ought not to be concerned, except to deal with professionals to assist you when making these judgments. Recently, we were able to reduce the horsepower on a series of drives from 10 to 7-1/2 by changing gears (pun intended).

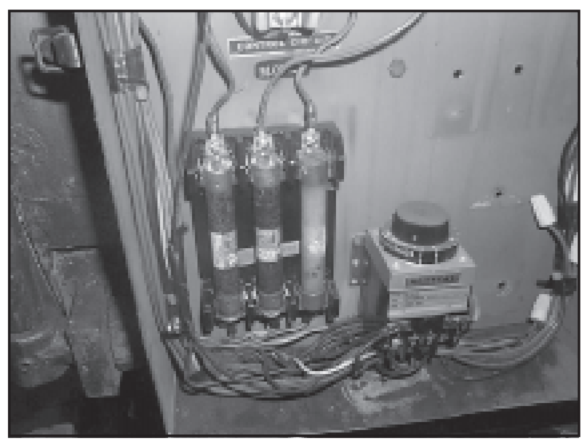
> ***Every electrical connection over time will become hot!***

Adjustable frequency drives (AFD's or VFD's) further affect the issue. Savings are literally remarkable but require competent application to maximize your investments.

Switching gears (oops, another pun!) for a moment, the assumption in all the above is that the job is finished when new equipment is installed **. . . not so!** Every electrical connection, over time, due to its resistance, will become hot due to current flow and its resistance. Recall with us the basic rule:

Power (watts) = (Amperes)^2 x Resistance

Power, in this case, is heat. Heat oxidizes and the rest is history. Too, connections become loose over time, furthering the problem With stranded conductors, the materials work and heat increases.



A Typical electrical equipment box that is not so typical. (See page 6)

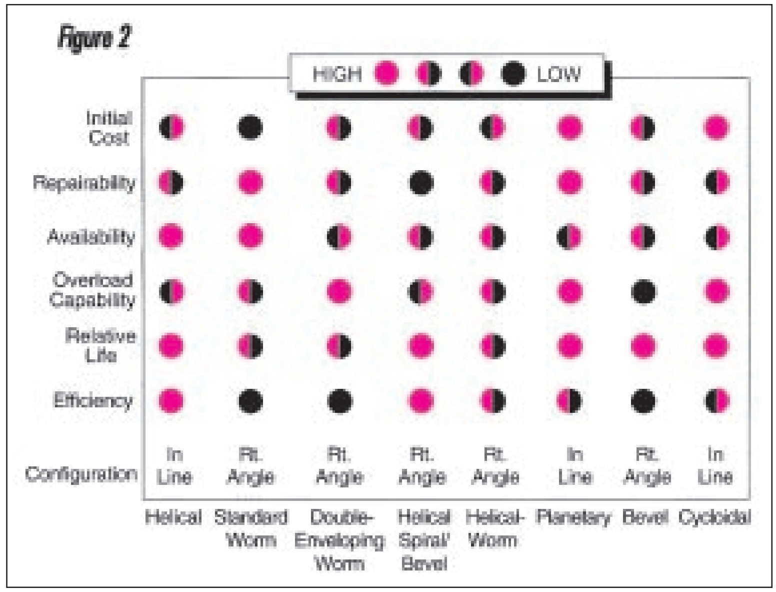
So what! These things, left unaddressed, result in failures and/or fires. Today, with modern infrared sensing equipment, we are able to detect these problems and "nip them in the bud" before they become destructive. A complete service to handle these issues is now available from **LONGO** under the ***TEGG*** banner.

“Switching Gears”
Can Cut Your Energy Costs

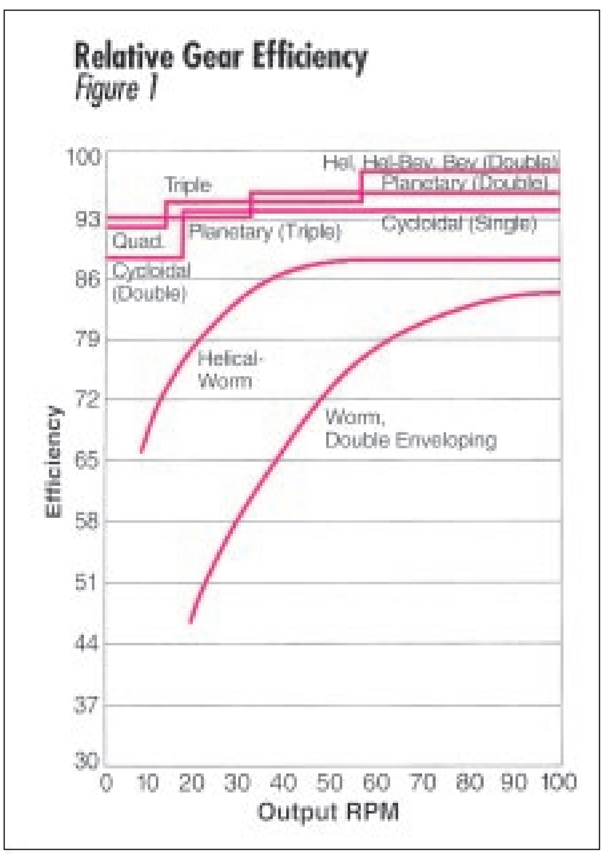
When trying to improve overall system efficiency, most people initially look to the electric motor. And while it is true that switching to an energy efficient motor is a smart investment in most cases, this is only part of the overall efficiency equation.

Most conveyor OEM’s have long standardized on worm gear reducers due to their low initial cost, long service life and ability to withstand high overloads. However, one of the drawbacks of worm gear reducers is their relatively low efficiency, especially at ratings below 20:1.

Take, for example, a constant speed belt conveyor system. The conveyor operates 4,000 hours per year and is driven by six, 2 HP, poly phase induction motors mounted to worm gear reducers with 40:1 ratios. The efficiency of the worm reducers is 67%. Each motor is operating at full load and has a nominal efficiency of 82%.



In our example you can see that an obvious candidate for replacement with a more efficient product is the worm gear reducer (see Figure 1). While a few points of efficiency can be gained from using a more energy efficient motor, much more can be realized from using a more efficient reducer combined with the original motor.



Much has been written about replacing worm gear reducers with their much more efficient cousins, in-line helical reducers. Making this change would not only offer energy savings from higher reducer efficiency, but also the opportunity to reduce motor horsepower.

Clearly, by implementing this type of solution, significant savings will be obtained by reducing kilowatt consumption since the motors would be operating at less than 3/4 load. In fact, the efficiency of induction motors actually increases slightly when operating at 75 percent load!

However, it is the role of the PT/MC distributor to educate customers that spending numerous man-hours of labor changing from one product to another could quickly eat up any potential energy savings. Changing from a right angle worm gear to an in-line helical reducer in this instance might also be questionable in its true cost savings, since implementation of this product change would necessitate a fair bit of re-work to the existing conveyor system.

Other Options

Right angle worm and in-line helical are the two most common types of gearing today in the industrial marketplace. However, there are other types of gearing which should be considered and may provide a better overall solution. The PT/MC distributor recommending a change in the type of gearing on any piece of equipment must not only be concerned with efficiency, but other factors such as:

- **Initial cost**
- **Repairability**
- **Ease of installation**
- **Availability**
- **Ability to withstand overload conditions**
- **Expected life**

The chart in figure 2 shows that changing the type of reducer involves making a number of trade-offs between these attributes.

The goal is to choose a reducer with the right performance characteristics while maximizing efficiency.

In the case of our conveyor example, the configuration and average overload capability of the in-line helical reducer may not make it the best choice, even though it offers the highest efficiency (see figure 1). A better choice may be a helical-worm reducer, which offers only slightly lower efficiency than the in-line helical while preserving the configuration and overload capability of the original worm reducer.

A comparison of total yearly energy costs reveals that only a small portion of the potential energy savings has been compromised (see figure 3). However, the energy savings compared to the original product are quite dramatic and will more than justify the increased cost of the helical-worm gear reducer.

Figure 3

Yearly Energy Costs of six, 2 HP Motor-Gear Drives operating 4,999 hrs./yr.

		Original Standard Efficiency Motor+ Worm Gear Reducer	Original* Standard Efficiency Motor+ In-line Helical Reducer	Original* Standard Efficiency Motor+ Helical-Worm Reducer
	Motor Efficiency	82.9%	83.6%	83.6%
	Reducer Efficiency	67.0%	94.0%	88.0%
	Combined	55.5%	78.6%	73.6%
Total Energy Costs Per Year	$.04/kW-hr	$2,579	$1,823	$1,947
	$.06/kW-hr	$3,868	$2,734	$2,920
	$.08/kW-hr	$5,158	$3,645	$3,894

*Efficiency of 2 HP motor operating @ 3/4 load = 83.6%.
Data based on U.S. Electrical Motors Unimount Motor.

The ability to make similar intelligent choices for users make PT/MC distributors an invaluable resource. These professionals can help determine the most cost efficient solution for any application. Utilizing their expertise will help to evaluate total energy consumption and the best options for your operation.

Longo recently completed shipment of four Reliance GV3000 variable frequency drives, complete with motors and reducers for a sheet steel coating line. Based on the customer's calculations and actual power requirements he had chosen 10 HP, 1800 RPM motors and 15:1 ratio right angle worm double shaft gear reducers for a 117 RPM final output speed. The calculations were based on a typical motor efficiency of 72%, total efficiency 60.4%.

Longo sales prevailed on the customer to look at the Reliance XE premium efficient motor and the Lenze helical-bevel type 14.4:1 right angle reducer. The efficiency of this package, motor 90.2% reducer 94%, yielded a total efficiency of 84.7%. Accordingly, the customer was able to go to 7.5 HP lowering both initial and operating costs. After having received the order, we had the components brought together at Wharton for assembly and a final coat of Reliance blue-green paint The drives have started up and are running flawlessly.

Article by:
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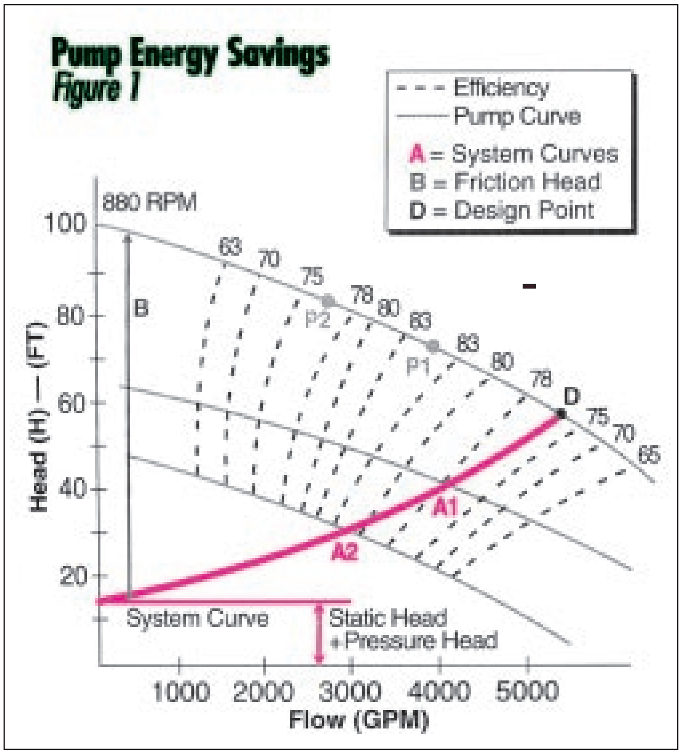
VFD Drive Technology Can Save Over 30% In Energy Costs

The evolution of AC drive technology has seen many changes in a relatively small time frame. If we look back just 15 years ago, the reputation of AC drives as a reliable and cost effective method of variable speed control was poor at best. The technology offered consisted mainly of analog controls and SCR (Silicon Controlled Rectifier) power devices. The AC products on the market at that time, for the most part, were physically large, expensive and unreliable.

But in recent years, the technology of AC variable frequency drives (VFD) has evolved into highly sophisticated digital microprocessor control, along with high switching frequency IGBTs (Insulated Gate Bi Polar Transistors) power devices. This has led to significantly advanced capabilities from the ease of programmability to expanded diagnostics. The two most significant benefits from the evolution in technology have been that of cost and reliability, in addition to the significant reduction in physical size.



Now that AC variable speed drives have become so accepted into the industrial market, the potential for retrofits and new installations remains very high. The growth and demand for AC drives in North America continues at a double digit pace, and is expected to continue well into the 21st century.

The requirement to reduce the need for additional electrical generating stations has created a benefit to the consumer in the form of demand side management. Utility rebates provide an excellent opportunity to upgrade and maximize efficiencies at minimal, or, in some cases, virtually no cost to the industrial user.

The applications with the greatest amount of energy savings are still centrifugal pumps and fans. It is estimated that the total market for AC drives in North America in 1995 is slightly over $600 million. Of that, 36%, or approximately $225 million, was spent on fan and pump applications.

Experience has shown that premium efficiency motors can deliver 2-8% energy savings over standard efficiency motors. However, the potential for energy savings by applying VFD's can exceed 30 percent based upon several variables. These variables are the original design philosophy of the pump or fan system, flow modulation method, duty cycle and electricity cost.

When looking to apply VFD control to an existing pump, a basic overview of the application should be investigated. If the original design philosophy was set for the worst case maximum flow condition in a future requirement, or if the original designer used a typical 20% oversizing criteria, there is a great potential for energy savings. However, if there have been expansions, and near full flow requirements are already in use, the potential savings may be limited. Proper evaluation is critical to accessing and correctly applying VFDs.

Energy savings also depends on the pump system's curve. A centrifugal pump operates at the intersection of its Head-Capacity Curve and the Systems Head Curve. The Total System Head is comprised of three components: 1) Static Head (Hs), 2) Pressure Head (Hp), and 3) Fric

Figure 2

$$\text{BHP (Break Horse Power)} = \frac{\text{GPM x Head (Ft) x Sp. Gravity}}{\text{3960 x pump efficiency}} : \text{KW} = .746 \text{ BHP}$$

Design Point D1: $\text{BHP} = \frac{(5000\text{ GPM})(58\text{ Ft})(1)}{3960(.76)} = 96.4\text{ HP}$

Valve Control P1: $\text{BHP} = \frac{(4000)(70)(1)}{3960(.84)} = 84.2\text{ HP } (62.8\text{ KW})$

P2: $\text{BHP} = \frac{(3000)(80.5)(1)}{3960(.77)} = 79.2\text{ HP } (59.1\text{ KW})$

VFD Control A1: $\text{BHP} = \frac{(5000)(46)(1)}{3960(.77)} = 60.3\text{ HP } (45.0\text{ KW})$

A2: $\text{BHP} = \frac{(3000)(28)(1)}{3960(.81)} = 26.2\text{ HP } (19.5\text{ KW})$

VFD Savings P1 (KW) - A1 (KW) = 62.8 - 45.0 = 17.8 KW

P2 (KW) - A2 (KW) = 59.1 - 19.5 = 39.6 KW

tion Head (Hf); refer to Figure 1.

The Static Head component is the elevation difference between the liquid level on the suction side of the pump and the point of liquid discharge. It is fixed in a system and does not vary with flow. The Pressure Head is established by the application or process and is also independent of flow.

The Friction Head in a system is compromised of all losses in the system (i.e. friction through piping, valves, fittings and pump entry and exit losses). It is flow dependent, and will vary as the flow through the system increases or decreases, or as additional restrictions occur.

Typically, when selecting a pump for a VFD retrofit, a design point is chosen (Refer to Figure 1). If valve restriction is the method of flow control, operation moves from D to P2 as the valve is closed. If the speed of the motor is varied, the pump curve shifts with each new speed, intersecting the system curve at the corresponding flow point.

The power savings for operating point A1 over P1 is 17.8 KW (Refer to figure 2). If the cost of electricity is \$.06 per KWH, and the system operates for 1,000 hours at 4,000 GPM, the savings utilizing an VFD, is \$1,068. If the flow is 3,000 GPM for 1,000 hours, the savings is \$2,376. As you can see, the savings can be significant over the life of the installation.

Additional benefits which are readily seen include: the reduction and/or elimination of motor starters, less stress on the AC motor windings and bearings, and a decrease in stress and wear on the pump or fan itself. This all equates to a smoother, longer lasting and more efficient operation process.

Equal to the advancement of VFD technology is the role today's power transmission/motion control distributors play in providing not only the VFD, but proper application knowledge as well. Great strides have been made by local power transmission/motion control distributors to provide application start-up and trouble-shooting assistance. All of these make distributors your primary source for investigating and providing cost effective energy saving solutions.

Article by:
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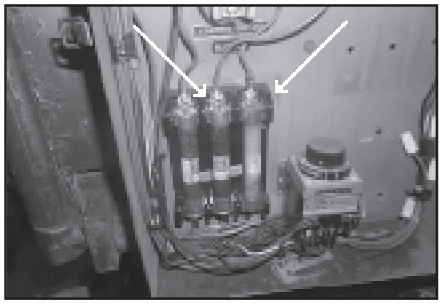
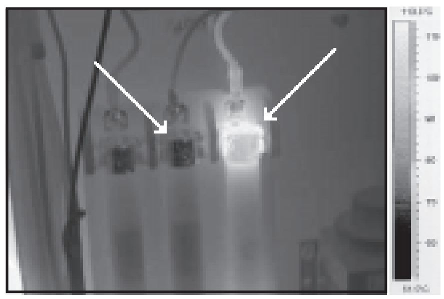
Another efficient and cost effective way to help you maintain your equipment by **LONGO**

Thermographic Imaging of your Electrical System . . . an integral part of our new *TEGG*® Service!

One of the most effective types of electrical predictive maintenance is Thermographic Imaging (Infrared Inspection). Whether inspecting a breaker panel in a building or connections on a transformer, the principle is the same. As the resistance to the flow of current increases, the temperature goes up. If left unchecked, the temperature will continue to rise until failure occurs. It could well be catastrophic with an explosion and /or fire. Thermographic imaging allows you to "see" the temperature "hot spots". This will assist in the decision of either fixing the problem in short order or continuing to monitor it until such time that it is possible to shut down the operation with the least inconvenience to your system (s).

Electrical applications, where benefits can be achieved, represent an enormous list of equipment and processes. Virtually every component from generation through to low voltage electronic boards can, and should, be inspected.





This black and white infra-red image indicates two things: the center fuse clip and conductor are "cold" indicating very little current flow; the right arrow shows a very loose fuse clip with a fire being imminent. Note the comparison on the scale at right.

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SPORTS QUIZ

1. During Joe DiMaggio's 56-game hitting streak, how many of his hits were singles and how many runs did he score?

2. Which NBA team drafted Dan Callandrillo of Seton Hall?

3. Can you name the basketball Hall of Famer who did not play football in college, yet was drafted by the Cleveland Browns in 1962?

4. Can you name the round in which the Green bay Packers drafted Bart Starr of Alabama in 1955?

ANSWERS:

1. He had 56 singles and scored 56 runs.
2. The Houston Rockets drafted Callandrillo in the eighth round of the 1982 draft.
3. John Havlicek.
4. Starr lasted until the 17th round.

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