Incorporating Intelligent Energy Savings and Predictive Maintenance in a Soft Start

Electric motors consume approximately one quarter of the electricity in the U.S. and are the main motive force in our commercial buildings, industrial facilities, and appliances. Everyone knows reducing energy consumption has become a priority for the U.S. Many new methods of reducing electricity are being considered, including new electric motor efficiency technologies.

Many electric motors are equipped with a soft start. A soft start's purpose is to bring an electric motor up to full speed gradually, thereby reducing starting inrush current and relieving mechanical stress on the motor and related equipment. Besides startup, mainstream soft starts do nothing to control the electricity consumed by the motor. A soft start only works from the moment the motor is turned on until it reaches full RPM.

With the first quarter of 2007, Power Efficiency (Las Vegas, NV) formally launched Energy Saving Soft Start Plus (ESS+), which incorporates all the standard features of a solid-state soft start with Power Efficiency's patented energy saving technology. The technology matches the voltage to the motor load in order to supply the precise amount of energy required to maintain the motor at normal operating speed (full RPM). Utilities and customers have tested the technology on numerous applications (granulators, MG set elevators, escalators, and stamping presses) and frequently qualify for utility efficiency rebates.

The ESS+ could replace existing starters and soft starts on new equipment or could be retrofitted into existing motor control centers. The ESS+ could also integrate with virtually any automation system, through a PLC or other control network architecture, and report the amount of energy savings. Further software developments would enable the ESS+ to report a motor's load characteristics and predict motor and equipment maintenance issues.

Saving Power

The first option that comes to mind is that low-tech solution: the power switch. There is no denying that the best way to save energy is to shut off the machine. However, such is not always possible. High efficiency motors are another option. Although more efficient than standard motors, high efficiency motors become inefficient when lightly loaded, just like standard motors. Installing a variable frequency drive (VFD) is another option; by equipping the machine with a VFD, it will slow down or stop when there is no load, or when it is lightly loaded, and will speed up again when load increases. Slowing or stopping the electric motor saves energy. Nevertheless, there are times when slowing the motor is not possible, or when a VFD is too expensive to be economical based solely on energy savings.

The Power Efficiency ESS+ keeps the motor running at full RPM, in contrast to a VFD, and reduces the power used by the motor when it is lightly loaded. The ESS+ is also expected to have a retail price comparable to other solid-state soft starts, which are far less expensive than most VFDs. Furthermore, the energy saving technology in the ESS+ makes high efficiency motors more efficient in the same way it operates on standard efficiency motors — augmenting their efficiency at low loads.

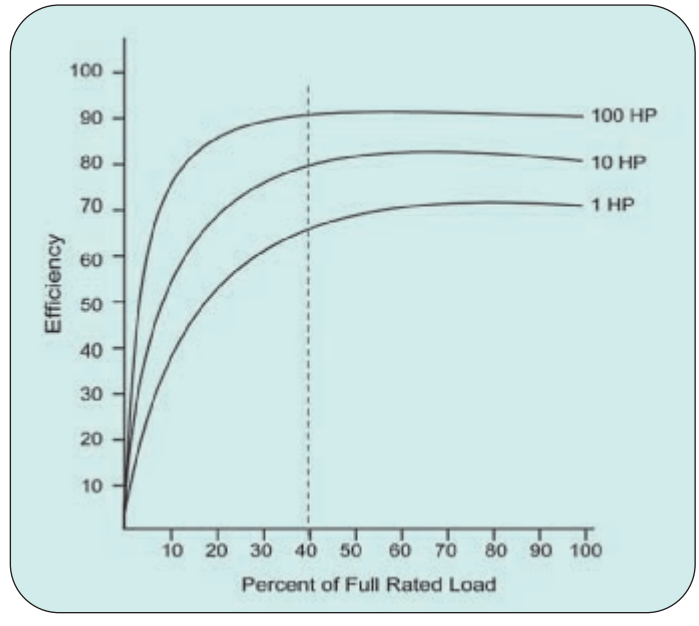

Figure 1. The efficiency curve for typical AC motors.

How It Works

In general, AC induction motors operate most efficiently at around 75% of full rated load. At roughly 40% of full load, a motor's efficiency begins to decrease. At even lower loads the efficiency drops off precipitously. Numerous motors operate at light loads. According to a Department of Energy study, 44% of motors in industrial facilities operate at 40% or less of full load and are operating inefficiently.

The efficiency curve for typical AC motors is shown in Figure 1. As a rule of thumb, the larger the motor, the flatter this curve is, and the lower the load per-

	Avg kW x 8760 hrs/yr	Annual kWH Use	Annual kWH x Cost per kWH	Annual kWH Cost
Without Energy Savings	6.08 x 8760	53,260.80	53,260.80 x 0.08	$4,260.86
With Energy Savings	4.01 x 8760	35,127.60	35,127.60 x 0.08	$2,810.21
Annual Savings	**34%**	**18,133.20**		**$1,450.66**

Figure 2. Up Escalator Annual Savings

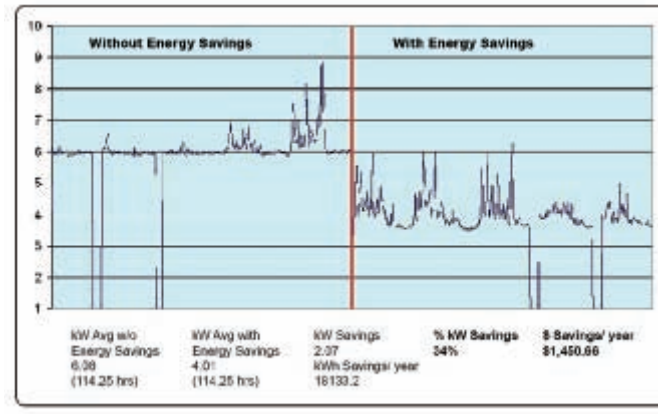

Figure 3. Up Escalator kW

centage has to drop before the efficiency starts to drop. The technology in Power Efficiency's ESS+ attacks the energy wasted when motors are lightly loaded — to the left of the dotted line in Figure 1. There is no opportunity for savings with the ESS+ technology when the motor is heavily loaded and operating efficiently.

To save energy, the ESS+ constantly monitors the voltage and current going to the motor. When the voltage and current sine waves diverge greatly — when the phase lag increases — the motor is lightly loaded and operating inefficiently. When this happens, the ESS+ technology reduces the current and voltage appropriately, while always maintaining the motor at a constant (full) operating speed. When the load on the motor increases, the ESS+ reads this condition and increases the power to the motor so it does not stall.

Although the theory of making motors more efficient in this manner was introduced many years ago, the process has been very difficult to perfect. The maximum amount of savings is realized across multiple applications and the motor receives full power when the load on it increases. Power Efficiency has created new technologies, including algorithms and software, to optimize the operation of the ESS+.

Results

Power Efficiency's energy saving soft start technology has been proven to save 25 – 50% of the energy consumed by an electric motor, depending on the load and operation of the machine. In a recent test by Nevada Power Company (the electric utility for southern Nevada) on an escalator motor at a major casino on the Las Vegas Strip, the device reduced the average power consumption by 34%.

Figures 2 and 3 represent the kilowatt usage of the escalator over a period of 10 days, displaying 5 days with the energy savings technology activated and 5 days without it. Other potential applications for Power Efficiency's soft start technology include rock crushers, compressors, conveyors, pumps, saws, mixers, shredders, and injection molding machines. With energy prices on the rise and increasing concerns about green house gas emissions, Power Efficiency introduces a smart option for energy savings on electric motors. Power Efficiency's patented energy saving technology and intelligent product features represent significant advancements in soft start capabilities for electric motor efficiency and the environment.

This article was written by John Hurst, Director of Engineering at Power Efficiency Corporation. For more information, contact Mr. Hurst at jhurst@powerefficiencycorp.com or visit ***http://info.hotims.com/10962-399.***