Managing Energy Costs: Turning Off Motors

Having a plan for motors is an essential component of a comprehensive energy management program. In fact, U.S. Department of Energy (DOE) statistics indicate that more than half of the electrical energy consumed in the United States each year is used by industrial electric motors.

One simple way to conserve electricity use is to turn motors off when possible. Given that DOE estimates 97% of the lifecycle cost of purchasing and operating a motor is energy related, reducing motor operating time by 10% could save enough in the cost of electricity to pay for three new motors.

Starting and Stopping Motors—Factors to Consider

Concerns are sometimes raised about the potential negative effects of starting and stopping motors, including the belief that repeated motor starts will use more energy than constant operation, increase utility demand charges, and shorten motor life. While these ideas are not without some merit, consider the following:

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- **Motor Electrical Use:** An extra inrush of current into a motor does occur during start-up until the motor reaches a full and constant speed. However, while a typical National Electrical Manufacturers Association (NEMA) Design B motor may draw six times its rated full-load current when starting, the start-up typically occurs in less than 2 seconds and rarely exceeds 10 seconds. Given this, just 1 minute of additional running time typically consumes far more energy than starting a motor.

  For example, consider a typical 50-horsepower, 3-phase, 460-volt industrial motor with a full-load current rating of 65 amps. Given a start-up time of 2 seconds, an inrush current of six times full-load current rating, a power factor of 0.85 and an electrical cost of 7 cents per kilowatt-hour, the starting cost for this motor is 1 cent. In comparison, the cost of constantly operating this motor for 1 minute is 5 cents.

- **Demand Charges:** Utility demand charges usually are based on a facility's highest electrical usage that occurs during any sequential 15- or 30-minute period during the billing cycle. While starting a motor does have the potential to increase demand because of inrush current, this excess demand is relatively small because of the short timeframe of the motor-starting interval.

  For example, consider again the aforementioned 50-horsepower motor that uses 44 kilowatts (kw) of electrical power. Given a 15-minute demand-metering period and constant operation, this motor would generate 660 demand units (15 minutes times 44 kw). If the motor is started and then constantly operated during this 15-minute period, the motor would create about 669 demand units—9 units at start-up (0.033 minutes times 264 inrush kw) and approximately 660 units for the remainder of the period. In this case, starting the motor at the beginning of the demand-metering period increased overall demand from 660 units to 669 units (1.3%). Notice that the 9 demand units associated with motor start-up essentially are equivalent to the demand units produced by continuously operating the motor for only 12 seconds. Therefore, shutting the motor off for more than 12 seconds during the demand-metering period would lower overall demand units, even if the motor was restarted.

- **Motor Starting Stress:** Starting a motor does place stress on it. High inrush currents can produce excessive temperatures that eventually may break down the insulation in the stator winding of the motor. When this occurs, overheating of the windings and rotor cage may lead to cracks and failed connections. Starting also places mechanical stress on the motor's components. Over time, the torque shock to the motor shaft from starting may shorten shaft life because of metal fatigue. In addition, electromagnetic forces on the motor's coils may reach 40 to 60 times normal during

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start-up acceleration, and cause coil fatigue and failure over time.

However, motors are designed to be started. And as long as the frequency of starts and starting load is not excessive, the life expectancy of a motor should not be affected adversely by starts and stops.

NEMA Standards Publication MG 10-2001 (R2007) provides standards for motors that consider load factors and appropriate motor run-stop-rest cycles. NEMA Standards Publication MG 10-2001 (R2007) also provides information on how actual work load may affect the recommended maximum number of starts per hour for a given motor.

Motor Management Practices

The following are several suggested energy-conservation practices to consider when using motors within your facility:

- Shut down equipment that is energized, but not in use for significant periods of time.
- Install automatic shutdown timers so that motors are turned off when running idle or unloaded for specified time intervals.
- Use adjustable speed drives or soft starters to reduce starting stresses in applications where frequent starting and stopping is required.

As long as the frequency of starts and starting load is not excessive, the life expectancy of a motor should not be affected adversely by starts and stops.

- Keep motors clean so that air flow and heat transfer during motor operation are not hindered.
- Do not overload motors; size motor loads appropriately.
- Develop a regular schedule for inspecting motors and driven equipment.

Conclusion

Reducing electricity use within an oilseed processing facility starts with managing the operation of motors. Evaluate how motors are operated within your facility, and consider developing a plan to reduce excessive run time. The time spent will be an investment in improving your facility's bottom line.

(Source: National Grain and Feed Association)