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US Government Premium Efficiency Motor Mandates:
Their Impact on Industries Utilizing Dust Collectors

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In an effort to reduce energy demands, the need to build new power plants, and greenhouse gas emissions, Congress passed the Energy Independence and Security Act of 2007 (EISA). Important information on the requirements and mandates for this law are detailed below. Dust collector owners, refer to tables on page 3 for EISA's impact on you.

Donaldson Torit RF Baghouse Collector

LAWMAKERS WANT TO SAVE ENERGY

According to the U.S. Department of Energy, motor-driven equipment accounts for 64% of the electricity consumed by U.S. industries. Converting these motors to more energy efficient models can reduce this energy consumption by as much as 12%. Therefore, in an effort to reduce energy demands, reduce the need to build new power plants and to reduce greenhouse gas emissions, Congress passed the Energy Independence and Security Act of 2007 (EISA). This law requires that all general purpose, three-phase AC industrial motors from 1 to 500 horsepower that are manufactured for sale in the United States December 19th, 2010 and later will need to meet mandated efficiency standards.

For plant managers, engineers and maintenance managers, this means that they will have a whole new set of variables to consider when deciding how to power fans that are required to draw dusty air through their dust collectors.

FEDERAL LAW BACKGROUND

Government mandated energy efficiency levels for motors are not really new. The U.S. Government required it in 1997 when it implemented the Energy Policy Act (EPAct), which also required minimum efficiency levels for motors. Since then, motor manufacturers have continued to make enhancements to motors that make them even more energy efficient. Because of this, the National Electrical Manufacturers Association (NEMA) developed a new standard for motor efficiency which NEMA trademarked as NEMA Premium Efficient™. EISA states that motors that were required to meet the EPAct standards in 1997, must now meet the NEMA Premium Efficient Standards, and a new group of motors must now meet the EPAct standards.

PREMIUM EFFICIENT MOTORS

To understand how the electrical efficiency of a motor can be improved, one needs to know how it loses energy. First of all, an electric motor could be considered a transformer of energy. It converts electrical energy into mechanical energy. Efficiency is a measurement of how much energy a motor uses in relationship to the rated power delivered to the shaft.

An electric motor loses efficiency several different ways, but the largest amount of loss comes from power losses caused by the resistance of electricity to flow through the motor. This resistance not only loses power, but it also generates heat. To reduce resistance, premium efficient motors contain about 20% more copper than standard efficiency motors. This means that in addition to saving energy, premium efficient motors will generate less heat, which is a benefit if the motor is working in an air conditioned environment. Less heat also means less wear and tear on the motor, so premium efficient motors generally last longer than standard efficiency motors.

Another way an electric motor loses efficiency is via slip losses. Slip is the difference in rpm between the rotational speed of the magnetic field and the actual rpm of the shaft. To reduce this slip, premium efficient motors have greater mass and conductivity in their rotor conductors.

WHAT DOES ALL OF THIS MEAN TO INDUSTRIES USING DUST COLLECTORS?

First of all, a company that buys a new dust collector with fan and motor in January of 2011 or later, will most likely find that it comes with a motor that meets EISA and may be considered NEMA Premium Efficient.

One key caveat to this is that it is only illegal to manufacture motors that don't meet EISA. It is still legal to sell motors that do not meet EISA, so companies should be sure to ask their supplier, if they are quoting a system with EISA compliant motors.

WHAT ABOUT MOTORS ON EXISTING DUST COLLECTORS?

When it comes to existing motors in plants, companies are not required by law to replace them with EISA compliant motors. In fact, if one goes bad, it is legal to have the motor rebuilt, or buy a rebuilt motor, rather than buying a new EISA compliant motor that may be slightly more expensive. But is rebuilding a good idea? Assuming a plant runs its collector 16 hours per day, 5 days a week, Column A of the table below shows how much energy it will consume annually with a motor manufactured before 1997. As a contrast, Column B shows how much energy a plant will consume using an EISA compliant, NEMA Premium Efficient motor. These calculations are based on industrial electrical costs of 10.7 cents per kilowatt hour, which was the national average in July of 2010. Here we see that the amount of energy saved is dependent upon the size of the motor. The 5 hp motor only saves $113 per year, while the 50 hp motor saves $710 per year. Assuming a plant uses these motors for 20 years, its lifetime savings are $2,266 versus $14,204.

Even though the federal government is mandating that all new motors manufactured meet the higher efficiency standards, some electrical utilities still offer rebates to incent companies to replace their functional but less efficient motors with NEMA Premium Efficient motors. For example Xcel Energy (covering states in the upper Midwest and West) offers a prescriptive rebate for 2010 of $300 for 5 hp motors and a $1,500 rebate for 50 hp motors, so companies should make sure they check with their local electric power supplier to see if they qualify for rebates.

HOW CAN A PLANT GET THE MOST OUT OF ITS NEW EISA COMPLIANT MOTOR ON ITS DUST COLLECTOR?

As is evident in the chart on the next page, using an EISA compliant motor on a dust collector can reduce a plant's annual energy consumption, but there are certain things that plant leaders can do to maximize their energy savings. The first thing plant leaders can do is control their motor and fan speed with a Variable Frequency Drive (VFD). These are also known as Adjustable Frequency Drives (AFD) and Variable Speed Drives (VSD), but for simplicity, we will call them VFDs.

A VFD can adjust the rotational speed of a motor, and thus a fan, by controlling the frequency of the electrical power supplied to the motor. Using one of these devices can save significant amounts of energy in a dust collector. For example, whenever an operator replaces the filters in a dust collector, there will be less restriction of airflow through the clean filters. If an adjustment is not made, there will be more cubic feet per minute (CFM) of air running through the system than required. This can be adjusted with a damper, but usually this will save little to no energy. However, using a VFD can easily adjust the airflow back down to the desired rate and save energy because less power is being consumed by the motor.

To maximize savings, a plant should use filters that are designed to keep the dust on the outer surface of the filters (surface loading filters vs. standard depth loading filters). Studies have shown that these filters stay cleaner longer because it is easier to pulse the dust off of these filters during the cleaning phase of the dust collector. Because of this, less static pressure is required to suck air through many of these filters meaning they may require as much as 2" less static pressure. If a plant combines these filters in the collector with a VFD on the fan and motor combination, the energy savings can really begin to stack up.

Column C in the table below illustrates the energy savings of a dust collector using surface loading filters

5 hp Motor, 3450 RPM TEFC, 2,199 cfm at 10.14"

	COLUMN A	COLUMN B	COLUMN C
	Pre-1997 Motor	EISA Motor	Surface Loading Filters with EISA Motor
RPM	3450	3450	3091
Static Pressure	10.14"	10.14"	8.14"
hp (bhp)	5.16	5.16	3.71
Kilowatts per hp	0.746	0.746	0.746
Load Factor	1	1	1
Annual Hours of Use	4160	4160	4160
Cost per kWh	$0.107	$0.107	$0.107
Motor Efficiency	84.50%	89.50%	89.50%
Annual Energy Consumption	$2,028	$1,914	$1,376
Annual $ Saved		**$113**	**$651**
20 year Life Energy Savings		**$2,266**	**$13,025**

50 hp Motor, 1584 RPM TEFC, 26,000 cfm at 10"

	COLUMN A	COLUMN B	COLUMN C
	Pre-1997 Motor	EISA Motor	Surface Loading Filters with EISA Motor
RPM	1584	1584	1417
Static Pressure	10"	10"	8"
hp (bhp)	49.6	49.6	35.51
Kilowatts per hp	0.746	0.746	0.746
Load Factor	1	1	1
Annual Hours of Use	4160	4160	4160
Cost per kWh	$0.107	$0.107	$0.107
Motor Efficiency	90.80%	94.50%	94.50%
Annual Energy Consumption	$18,139	$17,429	$12,478
Annual $ Saved		**$710**	**$5,661**
20 year Life Energy Savings		**$14,204**	**$113,225**

and EISA compliant motor with VFD, as compared to a collector that is using none of these energy saving strategies (Column A). The energy saving strategies are saving $651 on the 5 hp motor and $5,661 on the 50 hp motor on an annual basis.

Unfortunately, VFDs are not cheap. A VFD for a 5 hp motor can cost up to $3,900, while a VFD for a 50 hp can cost as much as $7,500. Electrical utilities understand how much electricity can be saved by using VFDs, so many utilities offer substantial rebates on this purchase. Xcel Energy, as an example, is currently offering rebates of $600 for a 5 hp VFD and $3,500 on a 50 hp VFD. So even though a VFD for a 50 hp motor costs $7,500, the final cost will be $4,000 after rebate. Then if a plant uses surface loading filters that require 2" less static pressure, it will be saving $5,661 in energy costs annually, which means that the VFD will pay for itself in energy savings in less than a year. Not only that, but over the 20 year life of this motor, a plant will save over $113,225.

A FINAL WORD OF CAUTION

It bears repeating that premium efficient motors are more efficient because they incur fewer slip losses. While higher efficiency is the name of the game, plants should know that a premium efficient motor may run at a higher RPM, which could result in a reduction of energy savings or in some cases increase energy consumption. A VFD will protect against this issue and produce the energy savings plants seek by helping to keep the airflow constant.

By combining various dust collection strategies with the new federally mandated EISA compliant motors, a company can save significant amounts of money through electrical consumption savings.

Control panel with VFD and airflow controls.

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