AR No. 6

High Efficiency Motors

Recommended Action

Premium efficiency motors use less energy to do the same work as standard motors. Install premium efficiency electric motors to replace 24 selected standard motors as they need replacing, rather than rewinding the existing motors. This will lead to greater efficiencies and decrease energy costs.

Assessment Recommendation Summary			
Energy (10^6Btu)	Cost Savings	Implementation Cost	Payback (years)
112	$2,306	$4,970	2.2

Background

Depending on horsepower, high efficiency motors operate from 1% to 10% more efficiently than standard motors. The savings are larger on smaller motors because the efficiency improvement is greater, and on motors that operate for long periods.

We recommend replacing only motors for which the size and operating conditions yield favorable payback periods. We base the cost on the premium of purchasing a new efficient motor over a standard motor. If you are comparing rewinding an existing motor with purchasing a new motor, you should consider the cost difference over a rewound motor. However, the efficiency of rewound motors may be several percent less than a standard motor wound at the factory.

Anticipated Savings

The Motor Efficiency worksheet (Appendix A.4) tabulates the demand, energy, and cost savings, premium cost, and payback for replacing all standard (900, 1200, 1800, or 3600 rpm) motors with energy efficient motors.

The demand savings (DS) can be calculated from the following equation for each motor

$$DS = D \times \left[1 - \left(\frac{\eta_0}{\eta_1}\right)\right] \times DF$$

where

D	=	Current motor demand (kW)
η_0	=	Estimated efficiency of existing motor
η_1	=	Efficiency of proposed energy efficient motor
DF	=	Diversity factor (Appendix A.1, A.9): 100%

The diversity factor accounts for the amount that a particular motor will affect the peak demand, and is a function of billed peak, lighting, and calculated motor demand and can be found in Appendix A.1, Motor Worksheet Definitions, and Appendix A.9, Diversity Factor.

Annual energy savings (ES) can be calculated from the following equation for each motor

$$ES = E \times \left[1 - \left(\frac{\eta_0}{\eta_1}\right)\right]$$

where

E = Annual motor energy consumption: kWh/yr

The total demand and energy savings are summarized at the bottom of the Motor Efficiency worksheet for all motors with a payback less than 10 years. The total demand (DS) and energy (ES) savings for replacing 24 motors as they need to be replaced are:

DS = 13.7 kW

ES = 32,791 kWh/yr

The demand and energy costs were taken from your current rate schedule. The annual demand cost savings (DC) are given by

DC = DS x Demand cost x 12 mo/yr
= 13.7 kW x $4.94/kW-mo x 12 mo/yr
= $812/yr

The annual energy cost savings (EC) are given by

EC	=	ES x Energy cost
	=	32,791 kWh/yr x $.04557/kWh
	=	$1,494/yr

The following is the Savings Summary Table.

Savings Summary				
Source	Quantity	Units	Energy 10^6Btu	Cost $
Electric Energy	32,791	kWh	112	$1,494
Demand	13.7	kW	0	$812
Total			112	$2,306

The annual energy savings (ES) is the amount of energy which could be saved after all the standard motors are replaced with high efficiency motors. However, the average motor lifetime is 12 years, based on Internal Revenue Service depreciation guidelines. Therefore, we assume that 1/12 of the motors at this plant will be replaced each year. The implementation cost and savings will occur over the life of existing motors as they need replacing.

Implementation Cost

From the Motor Efficiency worksheet, the total implementation cost for replacing all 24 motors as they need to be replaced will be

IC = $4,970

This cost is based on the cost premium of high efficiency motors over standard motors, for the various sizes shown in the table.

Assuming the implementation cost is incurred uniformly over a 12-year motor life, the annual implementation cost (IC) will be approximately $414 with an average payback period of 2.2 years. This is based on the assumption that the standard motors currently used will be replaced with high efficiency motors as the standard motors wear out.

The following table summarizes anticipated savings and payback period when all 24 motors are replaced with high efficiency motors.

Note: One way to keep track of which motors should be replaced with energy efficient models is to immediately paint a yellow "E" or other signifying mark on all of the motors listed above. If this is done, this report does not need to be referenced every time a motor needs to be replaced.

With the use of energy efficient motors, motor applications may operate at a slightly higher speed. In some cases this is an advantage. In other cases, you may want to reduce the pulley ratios when new motors are purchased. You can save additional energy by operating some applications at the same or lower speed.