If you know how much it cost to run that equipment

—could you make better operational and maintenance decisions?

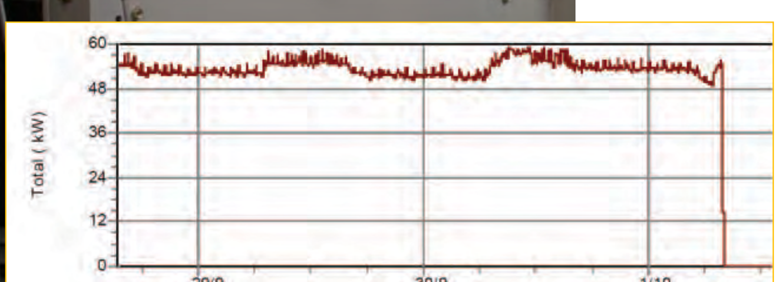
Application Note

Decisions have to be made—to save energy, to save dollars. Having hard data on which to base those decisions removes the “guess factor” and ultimately has a positive effect on the bottom line. Can recording data, analyzing results, and then making intelligent decisions really have that large of a dollar effect, though? The answer is “Absolutely yes!”

Comparing 200-horsepower air compressors

Consider this manufacturing plant example. The facility owned two 200-horsepower air compressors used for supplying plant air. Since compressor number one was rated at slightly more capacity in cubic feet per minute (cfm) than compressor number two, the decision had been made many months before to run compressor number one as the main compressor, and use compressor number two as the “trim” compressor. Thus, the trim compressor would run only when compressor number one was not able to maintain system pressure. This sounds logical, especially since they are both the same horsepower—there should be little or no difference in electrical operating costs.

Power loggers were installed on each unit for several days to determine the actual electrical energy operating cost. Each unit was run by itself to make sure its operation was not influenced by the other unit. Compressor number two was found to be significantly more energy efficient, and was also quite capable of supplying plant air needs.



Data logger software automatically graphs the energy usage for a 200-horsepower air compressor. This quick overview shows the compressor is averaging just over 50 kW of energy consumption during a three day period of operation. Knowing the electrical rate charge of $/kWh, it would be easy to estimate the cost of operating this compressor during this period.

Compressor number two was a newer, more energy-efficient design than its counterpart.

The facility was being charged $0.07 per kilowatt hour (kWh). The run times and kilowatt energy usage were extracted from the logged data and the actual operating costs determined. Such calculations are relatively simple and can easily be built into a spreadsheet for plant-wide usage. The bottom line: Operating compressor number two as the primary plant air compressor resulted in an annual estimated savings of $29,510. Obviously, logged data proved to be much more accurate than "best guess" based solely on nameplate data. Installing power loggers and later downloading data into a PC for analysis takes only a few minutes. A small investment in this case for a large return.

What does it cost to run fifty grinders during lunch break?

At another manufacturing plant the question was asked, "What is it costing to allow those fifty grinders to run during lunch break?" The logic for allowing grinders to run while not in use was that the grinders were relatively small loads as compared to much larger equipment, and the cutting oil would remain circulating throughout the grinder. And, since the grinder was effectively "idling" with no load, it just simply was not worth the effort to shut the grinder down for such short periods.

To verify the decision, a recording digital multimeter with an ac clamp was used to determine the actual operating cost of one grinder during the lunch break period. Interestingly enough, the savings came to only $0.55 for the one grinder. However, multiplying the fifty-five cents times fifty grinders yielded a lunch time savings of $27.50. Given the variables of shift work and holidays, the annual estimated savings of shutting off the grinders during the lunch periods came to just under $8,000. Once again, a thirty-minute check revealed a significant savings that could be achieved by the push of only two buttons per grinder: one for "stop" before lunch and one for "start" after lunch.

Operational costs for larger motors

Larger motors for various applications should always have their operational cost known. In one facility a 100-horsepower (HP) motor was used to pump water from a holding pond several hundred feet to where the water was used for process cooling. The motor ran continuously during plant operations. Other options were being explored for cooling water. The question that needed to be answered to determine payback before a decision could be made was, "How much is it costing us to run the current pumping system we have?" By recording the kilowatts consumed by the motor and the number of hours it was operating during a plant cycle, it was determined the 100 HP motor was almost always operating at its full capacity of 100 HP. It was costing the company $33,241 annually. Business decisions were then made to replace the existing system with a more efficient motor and pump design.

But, why not just rely on nameplate data to determine the cost to operate a motor? After all, NEMA motors are marked with required ratings including their horsepower and efficiency ratings. The answer is that motors rarely operate at their nameplate specifications. Expect actual operating costs to vary.

Readings averaged every 10 seconds over a one-minute period

Average watts consumed by the motor over the previous 10 seconds

Time	Active power total minimum (Watts)	Active power total average (Watts)	Active power total maximum (Watts)
08:10:07 0ms	32110.238	32097.152	32031.729
08:10:17 0ms	32064.441	32090.611	32142.949
08:10:27 0ms	32097.152	32103.695	32129.865
08:10:37 0ms	32097.152	32103.695	32149.492
08:10:47 0ms	32090.611	32123.322	32123.322
08:10:57 0ms	32084.068	32110.238	32136.408

Data Logger information imported into a spreadsheet for analysis. This 100-horsepower centrifugal pump motor, if fully loaded, should be consuming nearly 80,000 watts (80 kW). The 32,000 watts (32 kW) indicates the motor is only partially loaded, operating inefficiently, and that it may be a candidate for a VFD—which could result in significant energy savings.

For example, a 460-volt, three-phase, standard efficiency 100 HP motor operating under full load for 8,760 hours per year will probably cost just over $48,000 per year to operate at an electric rate of $0.10 per kWh. But, what if the motor is not operating under full load at all times? Then, the total operating cost can drop significantly. The only way to know for sure is to measure and record data. Then, analyze data and determine the true dollar value that the motor is contributing to that utility bill. Depending on the application, such a motor may be a candidate for large energy savings with the use of a variable frequency drive (VFD).

The cost of lighting

Lighting is one of the largest consumers of electrical energy in most industrial and commercial facilities. For example, annual lighting cost in a 160,000-square-foot industrial facility is approximately $85,030. Such dollar amounts can often be quickly and significantly reduced, if you know where to find the biggest savings. Many lighting options are available and selecting the right ones requires intelligent decision making.

The question becomes, "What does it cost to keep those lights on?" Then, estimates can be made for newer, more efficient replacement systems using published data. You can make fairly accurate estimates by counting fixtures, identifying lamp wattages and types, taking into account ballast operation, and knowing actual hours of which lights are on when. However, for decision making purposes, quick and accurate data can be achieved with simple ac clamp meter readings on lighting circuits in question.

As an example, certain fluorescent lighting was left on at a commercial facility for extended periods with what was thought to be good justification. A common misconception is that it is more energy efficient to leave fluorescent lighting on than it is to turn it off. This is true only to a certain extent, as savings are attributed to avoiding the small amount of inrush current when starting these lamps. Also, excessive switching off and on, such as several times per day, can shorten lamp life. The US Department of Energy general rule of thumb is that fluorescent lighting should be turned off if the room is left unoccupied for more than fifteen minutes. However, in some areas of the country this number might be as low as five minutes if electrical rates are high.

It is easy enough to use an ac clamp meter and measure the voltage and current supplied to a lighting circuit to quickly obtain accurate numbers. You can make a quick calculation for the cost to operate that lighting circuit. But what if you are assuming the lights are being shut off at certain times when, in fact, they are not? After all, you placed a sign reminding all workers to turn off all task lighting at workstations at the end of their shift. You probably will not be surprised that electrical current and kW do not go to zero on all such lighting circuits at the end of each day. So, how much are lights that someone forgot to turn off costing you? You won't know until you measure it. Then put up signs showing workers the dollar amounts associated with lighting expenses and you are sure to create some interest.

The per-hour cost of running equipment

Sometimes operations and facility managers simply like to know how much it costs to run a specific piece of equipment per hour. Such information should be provided at 100 percent load, 90 percent load, 80 percent load, and so on. Information can then be extrapolated by managers to make operational decisions. "What if I run press #5 on this project instead of press #3? Which one allows me to make the same part for less?" A fair question that should have a concrete answer.

It is easy to look at an electric utility bill and know what the charge is for the month. Managing and reducing that bill is the goal of energy management and requires the cooperation of all facility personnel. To make intelligent decisions you must know where that electrical energy is going each month. You must measure and record energy data on major pieces of electrical equipment and systems. Using a power logger for at least one plant cycle or more is best. Determine the hourly and annual costs to operate that equipment. Keep track of this data and have it readily available and know how much it cost to run your equipment. It is much more comfortable to make decisions based on fact rather than on estimates and best guesses.

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