Written by William C. Livoti
Monday, 19 April 2010 10:57

If your organization is focusing to any extent on cutting energy consumption, driving sustainable growth and reducing operating costs, it's a good idea to review power factor. Here's a very brief explanation.

The power factor (PF) of an AC electric power system is defined as the ratio of the real power flowing to the load to the apparent power, and is a number between 0 and 1 (frequently expressed as a percentage, e.g. 0.5 pf = 50% pf). Real power is the capacity of the circuit for performing work in a particular time. Apparent power is the product of the current and voltage of the circuit.

A PF of 1.0—or *"unity power factor"*—is the goal of every electric utility. If the PF is less than 1.0, the utility has to supply more current to the user for a given amount of power use. In so doing, it (the utility) incurs more line losses.

Industrial facilities tend to have a "lagging power factor," where the current lags the voltage (like an inductor). This is primarily the result of having lots of electric induction motors; as seen by the power supply, their windings act as inductors. Capacitors have the opposite effect; they can compensate for the inductive motor windings.

The significance of power factor lies in the fact that utility companies supply customers with volt-amperes, but bill them for watts. The relationship can be stated as:

watts = volts x amperes x power factor

Power factors below 1.0 require a utility to generate more than the minimum volt-amperes necessary to supply the power (watts). This increases generation and transmission costs. Utilities may impose penalties on customers that do not have good power factors on their overall buildings.

Watts—*or real power*—is what a customer pays for. VARS (volt-ampere reactives) are the extra "power" transmitted to compensate for a power factor less than 1.0. The combination of the two is called "apparent" power (VA or volt-amperes).

A low PF is expensive and inefficient—*some utility companies may charge additional fees when it's less than 0.95.* A low PF reduces the electrical system's distribution capacity by increasing the current flow and causing voltage drops.

Think of it this way: Based on personal experience, many of us would acknowledge that a mug of draft beer typically has a "head" on it. Let's say your favorite pub institutes a new policy—*you pay only for beer, not foam*
. While foam is simply aerated beer, it's not really usable. So, if your mug is half full of foam, you'll pay half the price. This is the same principle as electricity generation: The consumer pays just for the beer (real power), not the foam.

Main benefits from power factor correction:

- The utility's electrical load is reduced, thereby allowing it to supply surplus power to other consumers, without increasing generation capacity.
- Most utilities impose low PF penalties; by correcting the power factor, penalties can be avoided.
- High PF reduces load currents, which leads to considerable savings on hardware, such as cables, switchgear, substation transformers, etc. **UM**

Bill Livoti is a fluid power and power industry engineer with Baldor Electric Company. He also is vice chair of the Pump Systems Matter (PSM) initiative. Telephone: (864) 281-2118; e-mail: wclivoti@baldor.com