Written by Jim R. Johnson, Schneider Electric, North American Operating Division
Monday, 01 May 2006 23:33

Problems with the quality of power for electric arc welders should really spark your interest.They can reduce productivity, lower product quality, increase worker fatigue. How do those things impact your bottom-line?

Electric arc welders, such as those found in heavy manufacturing facilities or used in normal plant repairs, are certainly not a friend to power quality. They have several unique operating characteristics that, if not addressed properly, can decrease productivity and product quality and increase worker fatigue– *all of which can detract from your bottom line.*

Electrical contractors and facility managers working in these environments should be aware of these potential problems and how to identify them in the manufacturing process. Doing so early on can save considerable time and money in the long run.

Among the primary issues associated with the arc welding process is a sudden inrush current demand. Arc welders draw high levels of inrush current during their operating cycle, which is often only several seconds in duration. These high cycle-to-cycle currents cause the flux (magnetizing current) of the upstream transformer to saturate. Flux saturation causes the transformer output voltage to drop precipitously and results in failure or poor performance of the load. Put another way: *productivity is lost.*

Additionally, when the transformer output voltage drops, the source sees that drop and attempts to provide the needed current to maintain the faulting transformer voltage, thus creating an additional component to the current surge within the electrical system. This current surge accentuates the voltage drop of the source on an intermittent basis. If the voltage cycling is repetitive, it might appear as lighting flicker. Lighting flicker has been proven to increase worker fatigue.

Second, there's the intermittent operation for short intervals of time.When the weld is first struck, the welder requires essentially infinite current for a few cycles. During this period, the electrical system providing the power cannot provide all of the current demanded. The result is a voltage sag at the welder and a poor quality weld. In an automated manufacturing plant there are several welders on an electrical system fed from one power system. Simultaneous operation of multiple welders compounds the voltage sag problem and the incidence of poor product welds is greatly increased.

Finally, there's variability of the arc cycle-to-cycle. The first strike of the welder is especially unpredictable. This results in a difficult-to-define harmonic spectra. As the weld begins to flow, the harmonic spectra is more predictable with less amplitude of the peak current. However, the harmonic current still cannot be predicted. This unpredictabity, in addition to the very high cycle-tocycle peak currents at first strike, make selection of a harmonic mitigation method extremely difficult. If the harmonics are not mitigated, they can cause excess heat in the network, which can lead to a host of problems resulting in downtime and further productivity loss.

Solutions to these problems

Luckily, there are solutions that can be implemented through the electrical distribution system to address these power quality problems. Let's compare a couple:

Static VAR compensation. . .

One method of mitigation employed is the static VAR compensator. This device employs fixed banks of power factor capacitors, controlled with thyristors, which can switch them on and off rapidly. In many instances, there are also thyristorswitched inductors to prevent system resonance. Static VAR compensators maintain voltage levels, reduce voltage flicker, improve power factor, correct phase imbalance and improve system stability.

On the other hand, static VAR compensators are usually applied upstream of the system transformer, thus failing to correct the problem at the load and, consequently, failing to improve product quality. In addition, they are relatively slow compared to the welding phenomenon and, thus, not very effective.

Dynamic VAR compensation. . .

An alternative to the static VAR compensator is the dynamic VAR compensator, which is designed to inject current to support the current requirements of the load to reduce demands upon the upstream electrical system. The system transformer does not see the massive demand for inrush current and does not experience flux saturation. Therefore, the voltage remains stable at the load and in the upstream electrical system. All of the primary problems, like flicker, are eliminated.

In some advanced dynamic VAR compensators an analog current control algorithm is employed for ultra rapid response. This permits an instant-on feature to inject current during rapid load transitions, such as a first strike of an arc welder. It does not matter

whether this is a large harmonic or reactive load change. The device sees it through the current transducers monitoring the load and instantly responds by injecting as many cycles of peak injection current as required to support the load. As a result of this instant-on system, facilities with arc welding demands can maintain voltage levels, reduce voltage flicker, improve power factor and improve product quality and employee performance, thereby improving overall plant efficiency.

For manufacturing plants that use electric arc welding, having a solid understanding of the unique challenges and the most appropriate solutions associated with this process is a critical step in protecting the employees, the products and the bottomline. **MT**

Jim Johnson is the Accusine® PSC product line manager for the Square D Power Quality Corrections Group, a part of Schneider Electric's North American Operating Division.