Square D Reactivar® Hybrid VAR Compensation System

Improves Weld Quality and Minimizes Flicker at Pipe Manufacturer in Egypt

The Iron Pipe Industrial Company (IPIC) is a global manufacturer of large (6' diameter, 50' length) high-pressure steel pipe for oil and gas pipeline applications. Power quality was a primary consideration when IPIC engineers began planning the construction of a new state-of-the-art five megawatt manufacturing facility in Port Said, Egypt.

They planned on using submerged arc welders (SAWs) to close the seams of their pipes, and knew from past experience that SAWs, because of their large and rapid reactive power demand fluctuation, could cause severe voltage sag and flicker. This could undermine IPIC's operation because poor voltage regulation leads to reduced weld quality and can also impact weld line productivity. Additionally, IPIC engineers wanted to correct their facility's power factor in order to avoid costly utility-imposed energy and demand penalties. Similar installations faced penalties amounting to 12% of their annual utility bills for low power factor.

IPIC engineers contacted their local Schneider Electric sales team to learn about the latest voltage regulation and power factor correction technologies. The Schneider Electric team suggested the Square D Reactivar® Hybrid VAR Compensation (HVC) system. Utilizing a new design topology exclusive to Schneider Electric, the HVC system mixes fixed banks of standard, tuned or de-tuned capacitor banks and electronic VAR compensation to provide extremely rapid response and infinitely variable kVAR control never before seen in a power factor correction product. The unique design of the Reactivar HVC eliminates voltage sag and voltage flicker, while also correcting power factor and mitigating harmonics.

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SQUARE D

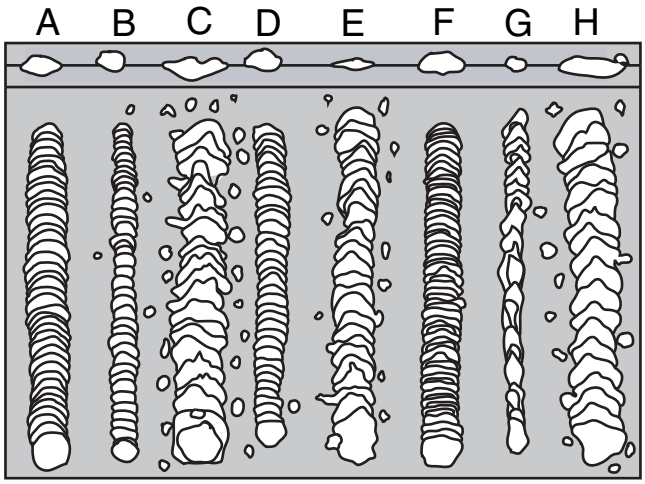
Facility Cost Savings Quickly Offset Initial Investment

In early 2004, IPIC installed two HVC units in their new facility, one 2000 kVAR unit and one 500 kVAR unit, and realized immediate cost savings from the advanced performance of these products.

Increased Productivity and Reduced Scrap

Voltage sag can cause poor weld strength, resulting in wasted scrap metal, or slowed production because the welded seams must be re-struck. Since voltage sag is especially pronounced when several welders are energized at the same time, IPIC engineers were keenly interested in finding ways to avoid this problem in their facility. A 15% voltage sag equates to a 28% reduction in power delivered at the weld tips. Figure 1 shows the effects of voltage sag on the weld profile.

Figure 1: Effects of voltage sag on weld profile



A. Normal
B. Low Amperage
C. High Amperage
D. Low Voltage
E. High Voltage
F. Low Speed
G. High Speed
H. Long Arc

In addition, voltage sag leads to voltage flicker, that can cause computer-controlled manufacturing equipment to trip off-line and cause facility lights to flicker, resulting in increased worker fatigue.

The Reactivar® HVC solves both of these power quality issues. It begins injecting reactive current within the first half cycle of detection, thus addressing the voltage change instantaneously. This eliminates voltage flicker and voltage sag, thereby increasing worker productivity and reducing the amount of scrapped parts; which ultimately helps to lower production costs.

Lower Utility Bills

The HVC helps keep utility bills lower by:

- Correcting power factor to unity
- Eliminating utility-imposed power factor penalty charges
- Saving energy by lowering I^2R losses

To accomplish this, the HVC dynamically adjusts the VAR compensation to meet system demands. The fixed portion of the HVC supplies constant leading VARS that can be offset with lagging VARS, or increased with additional leading VARS by the system's AccuSine® components. Consequently, with no load on the network, the HVC's two components will nullify each other and no compensation will occur. As quickly as the load changes, electronic adjustment of AccuSine can increase or reduce the injection of leading or lagging to match load demand and maintain unity power factor at all times.

Lower Substation Equipment and Bussing Costs

Due to the non-linear phase control action of the welders and the unsynchronized weld activity, adding capacitors alone to correct power factor would have created a resonant condition in the power circuit. This could have damaged standard capacitors, as well as other electrical equipment. In addition, standard contactor-actuated capacitor systems, designed to switch incremental amounts of capacitance every thirty seconds, would not have been able to respond to the very rapid cycling of the welders. Also, they would have generated transients, resulting in constant over and under compensation and potential damage to sensitive downstream equipment. Installing sufficient transformer and bus capacities to handle the unwanted currents would have been an expensive alternative to the HVC solution. The HVC reduces secondary load current and boosts bus voltage, enabling IPIC to optimize the size of the substations and bussing feeding the new line.

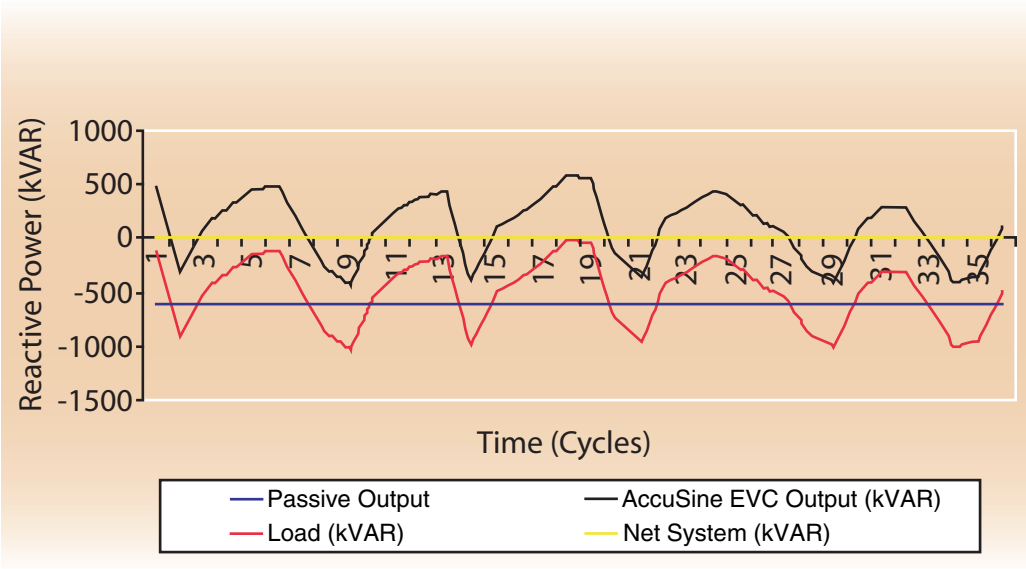
Reduced Repair and Maintenance Costs

The non-linear nature of the welders' current substantially increases the level of harmonics on the facility's network; causing bothersome tripping of protective devices and excessive heating in the bus and cables. This overheating could cause bus failure, resulting in very costly lost production and expensive repairs. By filtering the harmonics in the network, the HVC reduces the likelihood of heat-induced bus failure, and reduces the level of support necessary to repeatedly analyze and reset tripped protective devices. Fewer repairs and less maintenance mean significant cost savings.

AccuSine® HVC in Action

The AccuSine® HVC Load Tracking graph (Figure 2) provides an example of the HVC in operation. The dark blue line represents the fixed portion, the black line represents AccuSine, and the red line reprents the load. The yellow line represents the resultant load of the fixed and AccuSine components working together (the straight line representing the fixed will never change). AccuSine varies the amount of current injected to compensate for VAR fluctuations as necessary.

Figure 2: AccuSine HVC Load Tracking



AccuSine® HVC is the right choice

Applications that can cause voltage sag and flicker
Welders (Single & Three-Phase)
Chippers/Debarkers
Hoists
Cranes
Induction Heat Treaters
Electric Arc Furnaces
Amusement Park Rides (Roller Coasters)
Injection Molding Machines
Rock Crushers
Ski Lifts
Large HP FVNR Motor Starting
Forges
Presses
and many more

The new topology of the Reactivar® HVC system was designed specifically to address power quality problems experienced in industries with large cyclical and highly transient loads. In these applications, the poor voltage regulation caused by the unpredictable load cycling can seriously impact product quality and production line speed, and increase utility bills. Poor voltage regulation also impacts the utility network which in turn effects neighboring industrial plants, commercial buildings, and residential homes.

An HVC system is often a viable solution to address this issue. Benefits include increased system capacity, improved product quality, increased system reliability and proven energy savings.

For more information on Reactivar® Hybrid VAR Compensator systems, contact the Square D / Schneider Electric Power Quality Correction Group at (905) 364-3009. Or visit our web site at www.reactivar.com

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