Power protection solutions

Article
PCS100 AVC - How voltage conditioning improves productivity and lowers costs

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The fundamentals of manufacturing are quite similar to the time when Henry Ford introduced the production line to his factories at the beginning of the industrial revolution. This model, where production is organized into work stations and the product passes by each station, can been seen in every industry globally today. What has changed, however, is the product being manufactured and with this, the manufacturing tools required to produce that product. Instead of people welding car bodies together, there are robots, and painting is done with the help of electrostatic charges and final testing automated with computers. High quality electrical energy is now a must for modern factories to perform at their peak, and it's not just the control systems that are requiring power protection.

What are we protecting?

To decide what a customer needs for their power protection we need to understand several aspects;

1. What is the quality of the power supplied from the utility?
2. What happens to their process if there is a power interruption or sag?
3. What are the load types in the factory and their electrical requirements?

Often a factory manager will know details of point 2 and 3 but sometimes the power quality data from the utility is unknown. This may be because it is simply not measured by the utility, or it may be measured at the substation which may not accurately reflect the voltage at the customer's facility. They should however be able to answer the following question:

What most frequently causes problems for your facility power quality events or outages?

More often than not the answer is power quality events (unless the utility grid is very poor, outages are much less frequent). They may mention the momentary dip in the lights, after which under-voltage relays and variable speed drives have tripped. This is the clue that voltage conditioning is going to benefit this customer. Of course if its outages, ABB has a product offering of UPSs too.
The next important piece of the puzzle is what happens to the manufacturing process, during one of these power quality events, and the impact to the customer. This helps build an understanding of the business case for the customer.

Typically the more complicated the process the more chance of not being able to recover the product from the manufacturing line, resulting in scrap costs. There could also be considerable time needed to reset (clean or recalibrate) the production line which also costs, but as well introduces delays, meaning the customer may not meet their delivery schedules. In the worst case there could also be damage to equipment or product, not from the voltage sag itself, but often when the voltage recovers there can be a potentially damaging surge of current back into the equipment.

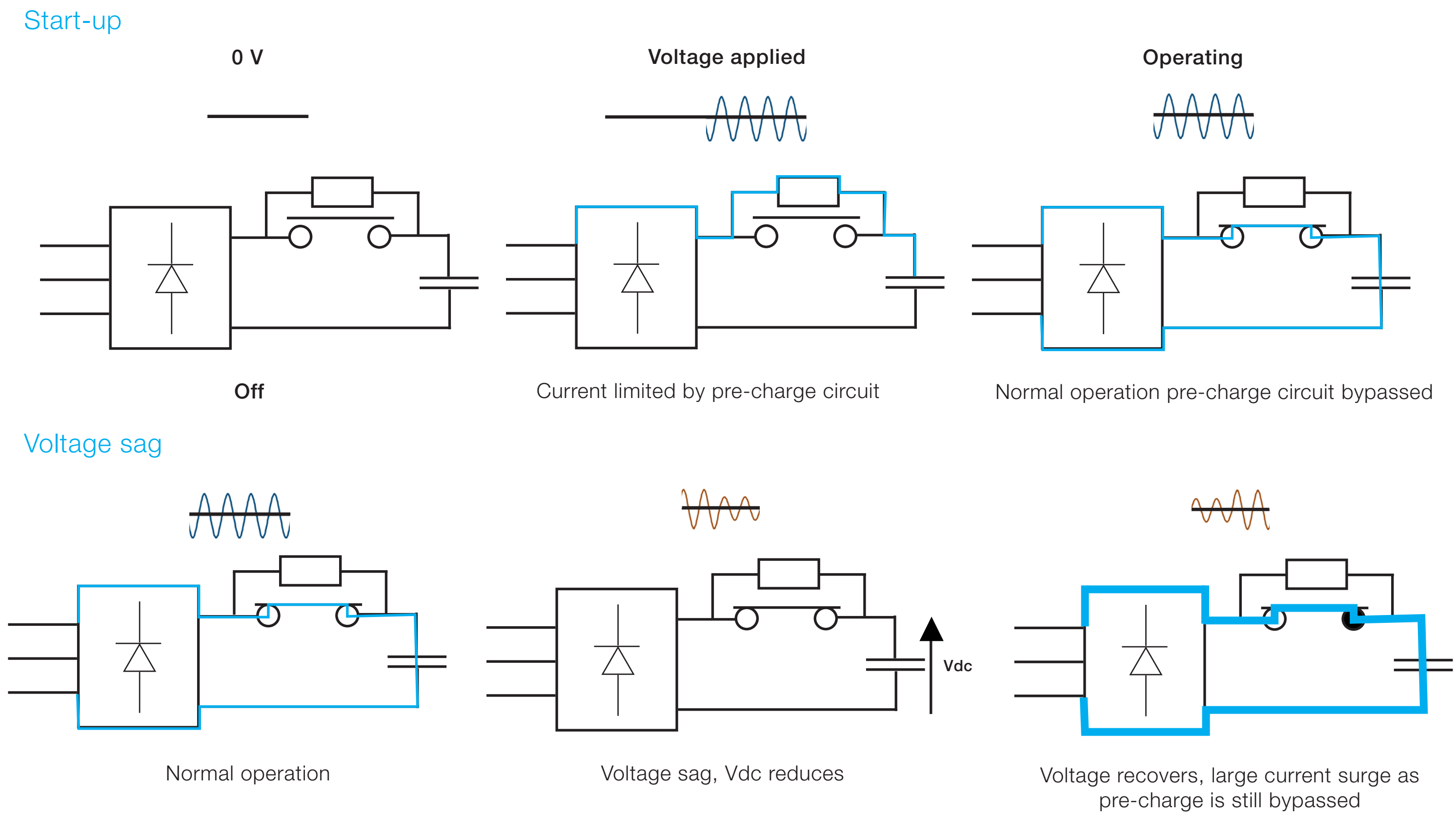

Figure one: **Top** normal controlled startup process. **Bottom** Inrush currents following a voltage sag

The graphic in figure one illustrates this problem. A typical front end rectifier for a power supply or variable speed drive is shown. During a voltage sag event there are two options for the behavior of this load.

1. Trip offline and perform a controlled restart. This may require operator intervention and will take some time.

2. Ride through the sag (if there is enough energy in the DC link capacitors). However when the voltage recovers this is where the problem lies and large surge currents can potentially damage equipment.

The smart utility grid, more or less reliable?

The utility grid is undergoing one of the biggest changes in structure ever seen. Buzzwords such smart grid and distributed generation are ever present in the media. Many have questioned the impact of distributed generation, in particular on grid reliability, and the consensus is the grid is becoming less reliable as a result. The issue is not so much outages, but voltage regulation due to generation at the distribution level, which was not designed this way decades ago. Coupled to this is the fact that this generation is intermittent, photovoltaic and wind, which presents a real challenge for utilities to maintain grid stability. While distributed generation is not helping, weather events are still the predominant cause of power quality events on the grid.

The graph in figure two on page three is a plot of the input and output voltages over one year from a PCS100 AVC installed in the Philippines.

This region is frequently battered by storms which causes havoc with the utility grid. During the storm season, voltage sags are extremely common, with 129 events recorded at the below site over 12 months. With the PCS100 AVC the vast majority of events are corrected back to nominal voltage.

Back to business

Installing power protection is only undertaken where there is a positive cost / benefit ratio for the customer. The benefit side is well known by the customer, this is their products and factory so they can calculate the benefit of fewer production interruptions and equipment failures. Obviously there is cost involved, however the PCS100 AVC offers an extremely competitive total cost of ownership, especially for higher power loads, where power protection costs may have been prohibitive in the past. The following table outlines costs and the features of the PCS100 AVC that minimize these.

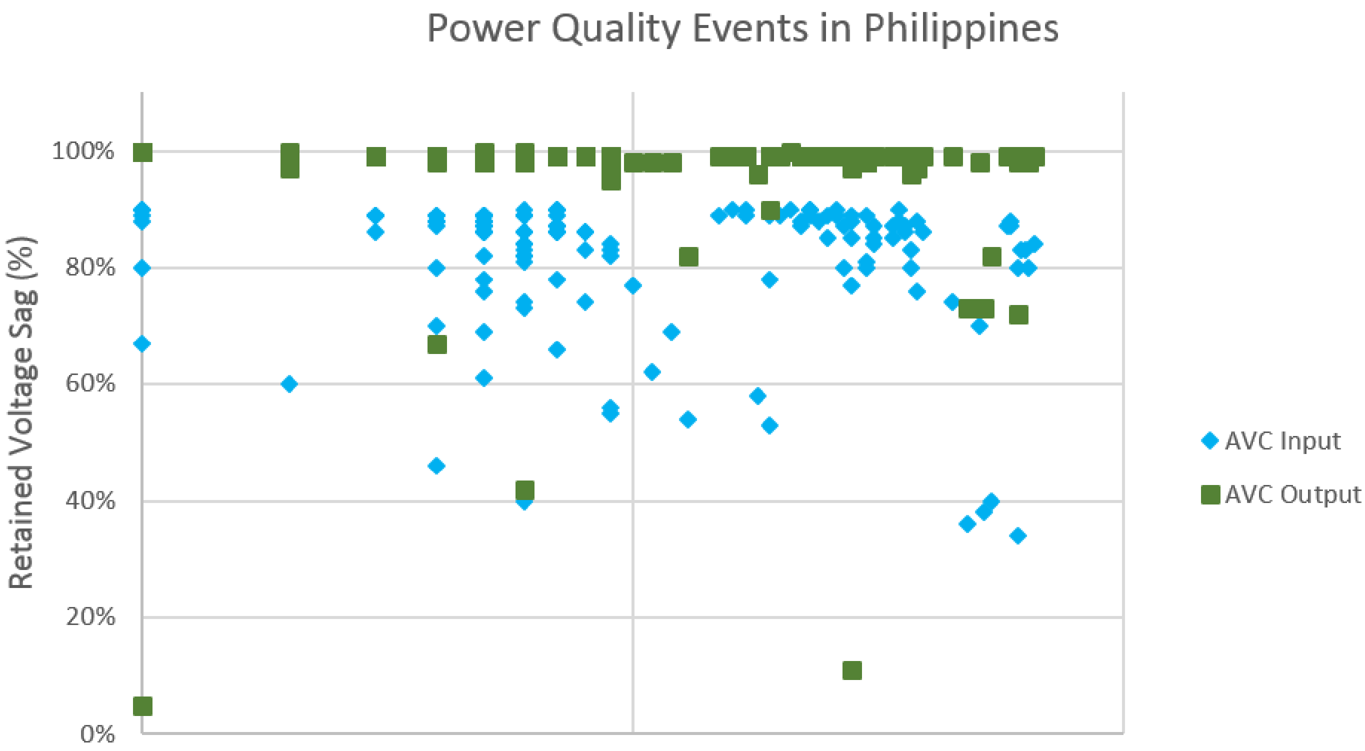

Figure two: Recording of PCS100 AVC performance

Customers cost	PCS100 AVC features
Capital costs	Competitive especially for larger loads where power protection costs may have been prohibitive in the past.
Installation	Small footprint. 3 phase AC in and 3 phase AC out are the only connections needed.
Operating costs - energy	Very high energy efficiency minimizing energy consumption and ventilation requirements.
Operating costs - maintenance	Minimal maintenance required. No batteries to maintain or replace, 20 year design lifetime with maintenance at 10 years (cooling fans only at 5 years).

Summary

The right power protection scheme for a customer is not always black and white. Understanding of the customer's process, utility quality and consequence when affected by events are all important. If there is a case for voltage conditioning then the customer can be assured that with over 685 MVA of PCS100 AVCs installed worldwide, they are joining a growing list of customers maximizing their productivity.

Click here to watch the PCS100 AVC video on YouTube (4.35 minutes)

To find out more about ABB's power conditioning, visit: www.abb.com/pcs100-power-converters.